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Moose Winter Distribution and Habitat Use in the Southern Williston Reservoir Area, British Columbia, 1989

D. F. Hatler
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PWFWCP Report No. 1

The Peace/Williston Fish & Wildlife Compensation Program is a cooperative venture of BC Hydro and the provincial fish and wildlife management agencies, supported by funding from BC Hydro. The Program was established to enhance and protect fish and wildlife resources affected by the construction of the W.A.C. Bennett and Peace Canyon dams on the Peace River, and the subsequent creation of the Williston and Dinosaur Reservoirs.

Peace/Williston Fish and Wildlife Compensation Program, 1011 Fourth Ave. 3rd Floor, Prince George B.C. V2L 3H9

Website: *www.bchydro.bc.ca/environment/initiatives/pwcp/*

This report has been approved by the Peace/Williston Fish and Wildlife Compensation Program Fish Technical Committee.

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Author(s): David F. Hatler[1]
Address(es): [1] Box 5, Smithers, B.C. V0J 2N0

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ABSTRACT

Aerial surveys focussing on moose were conducted in wildlife administrative units 7-29 and 7-30, fronting on Williston Reservoir, during the period 11-20 February 1989. Notes were also taken on incidental observations of other wildlife species and sign in the area, including caribou (over 200 seen and classified in the Wolverine Range), wolves (little sign and only 3 seen), mountain goats (6), Stone's sheep (5), and a variety of furbearers (common). A total of 467 moose were seen and 444 were classified to sex and age. Mean group size for the moose was 1.9 animals. They were widely dispersed, mostly below 925 m elevation, but the distribution was not homogeneous. The largest number of animals (320) was seen in M.U. 7-29, especially in the middle portion between the Manson and Nation Rivers. Most of the 129 moose observed in M.U. 7-30 were in the southern one-third of that unit. More than half of the moose groups and 60% of the individuals were seen in forest cutblocks, and only 11% of the groups and 14% of the animals were found in riparian habitats. Overall, it appeared that local riparian habitats lost during the filling of Williston Reservoir have been replaced (as non-climax wildlife habitat) primarily by forestry cutblocks. Preliminary observations on this survey indicate that silvicultural activities may threaten the productivity (for wildlife) of those new habitats. The primary recommendation is for initiation of a research project on silviculture/wildlife habitat relationships in the area. It is also recommended that a series of enhancement projects be instituted within non-forest habitats in the area, and a list of nine potential sites is given.

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WINTER MOOSE DISTRIBUTION AND HABITAT USE IN THE SOUTHERN WILLISTON RESERVOIR AREA, BRITISH COLUMBIA, 1989

1. INTRODUCTION

In 1961, construction commenced on the W.A.C. Bennett Dam across the Peace River, west of Hudson Hope in northern B.C. Despite the scale of that project, which produced a storage reservoir that became the largest freshwater body in the province, little consideration was given at that time to its environmental and social impacts (MOE 1982). For wildlife in particular, the first applicable study (Sumanik and Harrison 1968) was not undertaken until impoundment waters were already rising, and only an incomplete assessment could be made. After flood waters had stabilized in the early 1970's, government agencies commenced a review and planning process for resource management on lands surrounding the reservoir. Relevant documents include a report on a comprehensive inventory of wildlife use, distribution, and habitat in the Williston area (Bonar 1975), and a series of planning statements (MOE 1982, MOE 1983, MOE 1989a). The moose has been a focal species in all of the sources cited above.

Throughout British Columbia, winter range is a primary limiting factor for most ungulate populations (Edwards 1956, Demarchi at al. 1983). Studies of northern moose populations have shown that animals may move long distances from summer and fall ranges to suitable winter ranges, and that concentration on such ranges is common (Van Ballenberghe 1977, Eastman 1977, Schwab 1985). The nature and extent of winter migration, and the degree of concentration on winter ranges, may vary locally from year to year in relation to snow conditions. The general pattern in mountainous areas is for the animals to move downslope as accumulating snow impedes mobility and reduces forage availability. In most areas, the valley floors of major river systems constitute the ultimate winter range, i.e., where most of the animals will end up by at least the later months of most winters. The best of such areas are denoted as Class 1 or 2 in the provincial government's biophysical capability rating system (Demarchi et al.1983). Many of the valley bottom areas inundated by the Williston Reservoir are believed to have been in the higher capability categories (Sumanik and Harrison 1968).

It has been estimated that loss of critical winter habitat, drownings, and more subtle (less direct) effects of the hydro development resulted in a moose population reduction, in the entire Williston Basin, of from about 12,500 animals pre-flooding to less than 4000 afterward (Bonar 1975). A further, relatively quick reduction to "around 2000" over-wintering animals

has been hypothesized, due primarily to the effects of expanding local forestry operations--possibly compounded by the effects of flooding on timber supply. As suggested by MOE (1982), "With the high committment of remaining timber, there are little or no opportunities for integrated forest management to protect the remaining moose population."

In recognition of the wildlife losses attributable to hydro development in the area, early planning statements, e.g. MOE (1983), identified a need for significant compensation funding from B.C. Hydro and Power Authority to facilitate management and enhancement activities. Thus, the "Finlay-Omineca Strategic Environmental Plan", completed in 1984, could not be approved for implementation until recently, when a Compensation Agreement was reached (MOE 1989a). That planning document contains the following statement:

> Particularly for moose, the big-game species historically the most numerous and most widely sought in the planning unit, enhancement programs must be identified to reverse the trend to decline of the species. Although several areas have been tentatively identified as potentially suitable for habitat enhancement, detailed feasibility investigations (e.g., current habitat conditions, and potential for enhancement), and species inventory are required before any firm management decisions can be taken. In addition, cooperation from the forest industry is needed to maintain critical mature forest in those areas during the beneficial period following enhancement.

Among the activities identified as required in the early stages of plan implementation for moose are a) "inventory", and b) identification of suitable enhancement sites. The present project, commissioned by the Ministry of Environment and payed for by B.C. Hydro, is directed to those ends.

2. STUDY AREA AND OBJECTIVES

The study area, as designated by MOE, consisted of the two administrative management units (7-29 and 7-30) flanking the southern half (Parsnip Reach) of Williston Reservoir (Fig. 1). The primary objectives for the surveys in those units were:

a) To document moose composition, winter distribution, and habitat use.

b) To assess present moose habitat conditions and enhancement potential.

It was understood that a secondary, but also important objective was to gather occurrence information on other wildlife species in the area, as encountered incidental to the moose surveys.

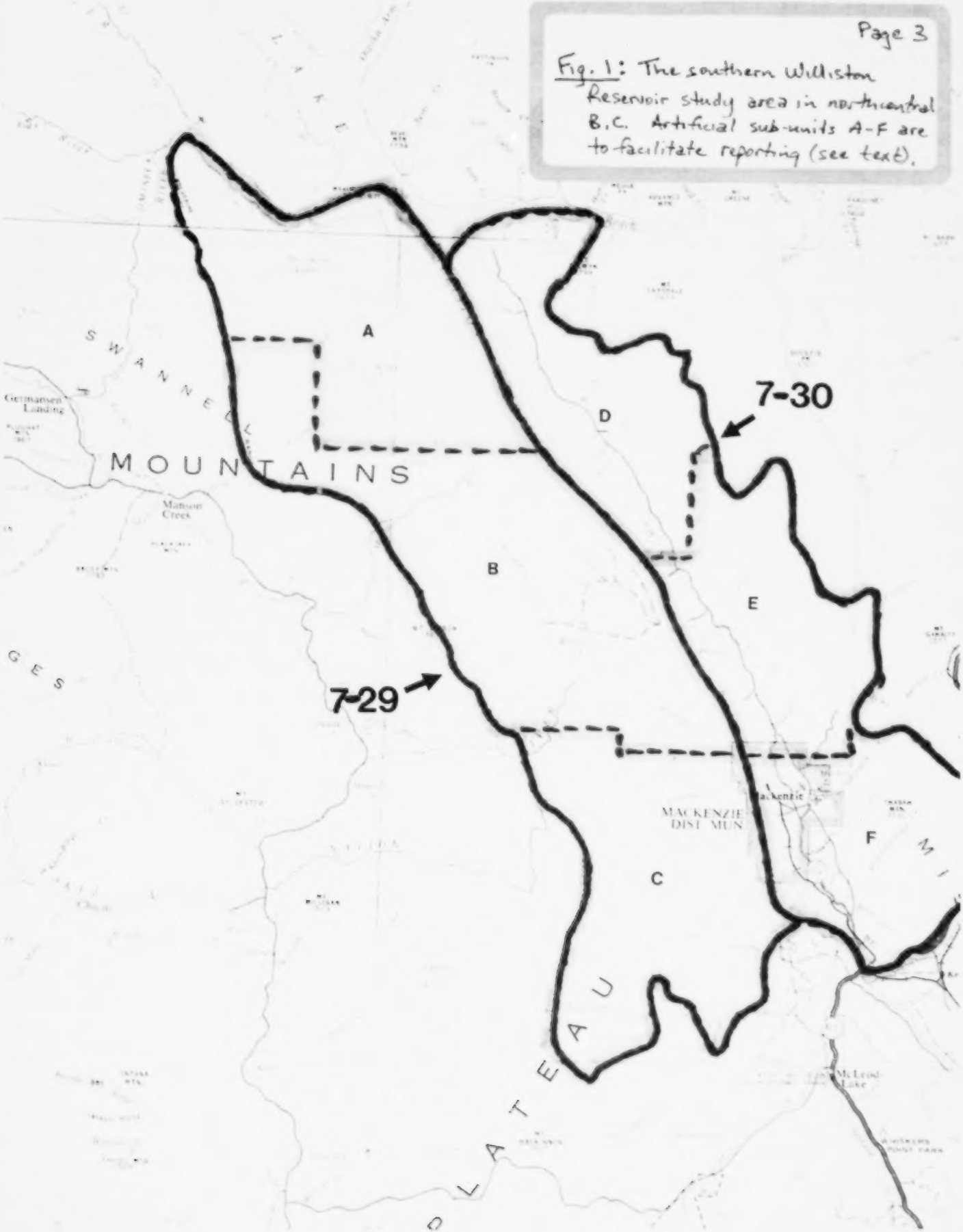


Fig. 1: The southern Williston Reservoir study area in north-central B.C. Artificial sub-units A-F are to facilitate reporting (see text).

3. METHODS AND CONDITIONS

3.1 Survey Characteristics

The primary data gathering was accomplished by 57.6 hours of aerial surveys, in a Bell 206 (Jet Ranger) helicopter, over the period 10-20 February 1989. Fulfillment of the objectives outlined above required that the surveys be both extensive and flexible, enabling full exploration of the area. Thus, the kind of systematic, pre-determined flight pattern required to provide statistically reliable population estimates was not appropriate. Rather, particular areas were pre-selected for coverage, considering logistical and weather factors, but the specific flight path was determined while the survey was in progress. The intent was to observe at least local samples of all prospective moose wintering habitats in each area, and to classify (male, female, juvenile) all animals observed. Flight speed during intensive searching averaged about 80-90 km/hr, and altitude above ground level varied from about 50 to 150m, depending upon local light conditions and vegetative cover characteristics. The primary pilot and front observer/navigator had considerable experience in aerial wildlife work; the other observers, though less experienced, all demonstrated unusual competence in spotting and classifying animals.

3.2 Navigation, Mapping, and Note-taking

The maps used for navigation and primary data recording were all from the National Topographic Series, at a scale of 1:50 000. Flight lines, locations/numbers of animals and sign, and occasional habitat notes were all recorded directly on the maps, in flight. A small hand-held tape recorder was used concurrently to log composition data and more expansive notes on each observation or on local habitats, as required. Initially, navigation was strictly by natural terrain features (streams, lakes, relief), as depicted on the flight maps. It quickly became apparent, however, that some of the most conspicuous features in the area were man-made, in the form of forest cutblocks. Thereafter, maps showing cutblocks were obtained and the blocks were traced onto the flight maps prior to survey time. That modification greatly facilitated navigation and accurate location of observations on the maps, although in some areas composed of several large, contiguous cutblocks, some navigational problems were experienced. Observations of moose were numbered both on the map and in the narrative description, to facilitate referencing during both analysis and reporting. One "observation" consisted of single animals, or of two or more that were either clearly together behaviorally or within 50-75 m of each other.

3.3 Survey Conditions

Although flight and observer characteristics, as described above, are important to the success and repeatability of surveys, other factors must also be considered in the interpretation of survey results. Climatic factors are particularly important, affecting both the distribution and visibility of animals and sign. Following are some comments and caveats that seem applicable in the present case.

Annual Variation - Although qualitative factors such as snow density and consistency probably play a role, simple snow depth--as it affects both animal mobility and the availability of forage--is probably the primary factor mediating moose seasonal movements and selection of winter habitats in most areas. In a review, Eastman (1977) identified three classes of snow depth in relation to moose mobility: shallow (0-40 cm, in which moose experience little or no hindrance to movement), medium (41-80 cm—moderate impediment to movement), and deep (greater than 81 cm—movement difficult).

Since regional snow accumulation may vary from year to year, it follows that regional moose distribution may also vary accordingly. That is, the single "snapshot" represented by a mid-February survey such as that reported here should be considered in the context of the particular winter and not necessarily as a reflection of animal distribution at that time in all years. Time did not allow a detailed weather analysis, but a summary of official snow survey information (MOE 1989b) indicates that as of 1 February, the mountain snowpack in northern B.C. was the highest reported since 1976, and that in the Peace River Basin the snowpack was 129% of the long-term average. It is noted that the primary differences were at upland sites, thus the interpretation for moose distribution is that the animals should have been concentrated at the lower elevations to a greater extent during the present survey period than has been the case for several years previous.

Local Variation - Even within years, wind, sun, topography, vegetative cover, and microclimatic factors combine to result in some locations having less snow than others. To help explain the animal distribution observed in the current surveys, measurements of snow depth were taken at several sites throughout the study area. The sites selected were all relatively level, undisturbed and, to the extent possible, protected from excessive wind action. At each site, snow measurement consisted of a series of three probes with a home-made measuring stick (2 x 5 cm) calibrated and marked in cm from 0-130.

Short-term Effects - Another feature of snow occurrence as related to wildlife surveys is timing. A survey soon after a fresh snowfall will find

fewer tracks than one conducted later, but will be more likely to locate the individual animals that made them. In the present case, there had been no significant snowfall in the area for 2-3 weeks prior to the survey. Thus, tracks had been accumulating, providing a good visual record of the distributional extent over that period, but making it difficult to either locate animals by tracking or to estimate the numbers present at areas of intensive use.

Insolation and Visibility Effects - Clear skies and bright, sunny conditions prevailed over most of the study period. That provided excellent visibility conditions for observation of animals and tracks in most cover types. However, moose appear to spend more time in timbered habitats under such conditions (Hatler unpubl.), possibly seeking shade in response to "thermal stress" (see Schwab 1985), and evidence from tracks suggested that was happening during these surveys. Owing to high contrast and heavy shadows, especially early and later in the day when the sun was low, visibility of both animals and tracks was poorest in conifer cover, therefore the extent of their occurrence in that type is under-represented in the results.

Summary, survey conditions - The subject surveys were undertaken under generally good visibility and flying conditions, in a somewhat heavier than normal snowpack situation, but some weeks after the most recent significant snowfall. Conditions were ideal for mapping distribution, but probably not for maximizing observations of animals.

4. RESULTS

4.1 General

The focus of these surveys was description, not analysis, intended primarily to provide managers with a useable database and some ideas. The basic narrative description of survey results is given in Appendix 1, a detailed flight report organized chronologically over the study period and covering all wildlife species observed. Location and environmental data relating to each moose observation are summarized, in tabular form listed by observation number, in Appendix 2. That compilation, which is the most amenable to detailed data analysis, is also being provided as part of the report package on floppy disk (spreadsheet file "HYDRO-89.WRK", prepared in Symphony 1.0). Two sets of maps have been prepared. The first is a folio of the 13 full-sized (uncut) topographic mapsheets within which at least some survey coverage was obtained. It has been my experience that such large maps have a way of becoming separated from the applicable reports in government

files, and/or that large maps may at times be inconvenient for the user. Thus, a second set of 40 page-size maps, at the same scale and bearing the same information as the large maps, is included here as Appendix 6.

4.2 Moose Population Data

Following are some data summaries and preliminary findings as related to the species of primary interest in the February 1989 surveys.

Numbers and Composition - Table 1 summarizes moose distribution, population, and group size data for the areas surveyed, organized by the Management Unit subdivisions depicted in Fig. 1. Of 449 moose observed in the primary study area (M.U.'s 7-29 and 7-30), 444 were classified to age (adult/young distinction) and 429 were classified to both age and sex. Composition percentages and ratios for that area are as follows:

	Male		Female		Juv.		Uncl.		Ratios per 100 cows		
M.U.	No.	(%)	No.	(%)	No.	(%)	No.	(%)	Total	Bulls	Calves
7-29	95	(30)	164	(51)	52	(16)	9	(3)	320	57.9	31.7
7-30	38	(29)	63	(49)	17	(13)	11	(9)	129	60.3	27.0
Both	133	(30)	227	(51)	69	(15)	20	(4)	449	58.6	30.4

Mean group size for the entire sample, including 18 animals seen in M.U.'s adjacent to the primary study area, was 1.9. The largest group observed was in M.U. 7-29, just south of the Manson River (11 animals scattered in a loose association through a small forestry cutblock). Only 13 of the 241 observed groups (5.4%) consisted of more than 3 animals.

Distribution - Although the group size data are reflective of a considerable dispersion of animals, the distribution was not homogeneous throughout the study area. The highest numbers and greatest concentration of sign was in the middle section of M.U. 7-29 (area "B" in Fig. 1, particularly between the Manson and Nation Rivers). The southern section yielded the lowest count of the three areas in M.U. 7-29, but that may be a result of visibility bias. There was abundant sign throughout the eastern portions of that area, from the lower few km of Tsedeka Creek to the mouth of the Pack River, but the habitat in that area includes patches of conifer cover as well as good foraging opportunity, and the animals were difficult to see. The pattern in M.U. 7-30 is clear--except for a small pocket of animals in the vicinity of lower Weston Creek, there were few animals and little sign in the northern two-thirds (areas D and E in Fig. 1). Most animals and sign in 7-30 were in the south, especially in the expanse of old cutblocks along Gagnon,

TABLE 1. MOOSE NUMBERS AND COMPOSITION IN THE WILLISTON RESERVOIR AREA, BRITISH COLUMBIA, AS OBSERVED IN AERIAL SURVEYS, 11-20 FEBRUARY 1989.

LOCATION[1]	NO. GROUPS	MEAN GROUP SIZE	NO. MOOSE	COMPOSITION[2] MALE	FEMALE	JUV	U-ADULT	UNCL
7-29 North	43	2.1	90	29	45	16	0	0
7-29 Middle	94	2.0	188	55	100	30	3	0
7-29 South	23	1.8	42	11	19	6	5	1
ALL 7-29	160	2.0	320	95	164	52	8	1
7-30 North	19	1.8	35	8	22	3	0	2
7-30 Middle	17	1.5	25	6	10	4	3	2
7-30 South	37	1.9	69	24	31	10	4	0
ALL 7-30	73	1.8	129	38	63	17	7	4
BOTH M.U.'s	233	1.9	449	133	227	69	15	5
OTHER[3]	8	2.3	18	9	3	3	1	2
GRAND TOTAL	241	1.9	467	142	230	72	16	7

[1]Wildlife Administrative Management Units (M.U.'s) 7-29 and 7-30, which comprise the primary study area, have each been artificially subdivided into three geographical sub-units (North, Middle, and South, see Fig. 1) to provide a clearer picture of local moose distribution. For the purposes of this compilation, those sub-units are defined in terms of the individual maps (all or portions thereof) in Appendix 6, as follows:

7-29 North (A in Fig. 1): Maps 2-7,9,10, and 11.
7-29 Middle (B in Fig. 1): Maps 13-16,18-20,22,23, and 24.
7-29 South (C in Fig. 1): Maps 26-28,31-34,37, and 38.
7-30 North (D in Fig. 1): Maps 8,11,12,16, and 17.
7-30 Middle (E in Fig. 1): Maps 20,21,24, and 25.
7-30 South (F in Fig. 1): Maps 28-30,35-36, and 40.

[2]Composition: Males, Females, U-Adult - all known yearling or older; Juv = young-of-the-year (about 9-10 months old at survey time); uncl. = animals only seen briefly, and neither sex nor age determined.

[3]Other: M.U. 7-38 (Obs. Numbers 1-5 in Appendix 2, 14 animals); M.U. 7-24 (Obs. Numbers 210 and 211 in Appendix 2, 3 animals), M.U. 7-28 (Obs. Number 213 in Appendix 2, 1 animal).

Gataiga, and Mischlnsinlika Creeks. As with the southern section of 7-29, good cover characteristics in those areas probably resulted in an under-representation of numbers. Figure 2 provides a summary glimpse of moose distribution and relative abundance in the study area, as compiled for the page-size maps in Appendix 6.

4.3 Moose Habitat Data

Habitat Characteristics and Use - More than half of the moose groups and nearly 60% of the animals seen during these surveys were found in forest cutblocks, and if sightings in timber adjacent to cutblocks is added, the applicable figures are 61% and 64%, respectively (Table 2). Only 11% of the observed groups and 14% of the animals were found in the riparian and wetland habitats commonly occupied by wintering moose in many areas. In some cases, such as along the lower reaches of Strandberg Creek, Fries Creek, Eklund Creek, and the Nation River in M.U. 7-29, flooding from the reservoir had clearly reduced the potential for riparian winter use, although cutblocks in the extensive, flat lowlands adjacent were making up for the flood losses to at least some extent. For M.U. 7-30, on the other hand, it seems apparent that the small amount of land area remaining between the base of west-facing mountain slopes and the reservoir is inadequate, even with logging, to adequately replace wintering habitat lost to flooding. It is likely that the ultimate winter range for most of the moose population that formerly occupied that area in summer (drainages from Mackenzie northward) was the main Parsnip Valley.

Time does not permit analysis of habitat use by sex/age class, although the relevant data are given in Table 2. It should be mentioned, however, that these extensive surveys tended to confirm a previous suspicion I have had about the distribution of cow/calf pairs. Although they were seen in all habitats and at all elevations, extreme outliers--animals in thick conifer or at high elevation--well away from most other moose--often were cows with calves. That result is similar to the situation I have described for caribou in the Spatsizi area (Hatler 1987), and has important implications for composition surveys that focus on riparian habitats.

Elevation - The mean elevation for moose sightings in the survey area (Table 2) was just under 800 m (about 2600'). Maximum high water in the reservoir is shown as 671 m on the NTS maps used, thus the elevational extent of useful winter habitat remaining in the area appears to be relatively narrow. In fact, nearly half of all moose groups (48%) and individual animals (45%) were at or below 750 m, and 62% of groups and 60% of observed moose were

FIG. 2:

Distribution and relative abundance of moose in the southern Williston Reservoir, as observed during aerial surveys in February 1989

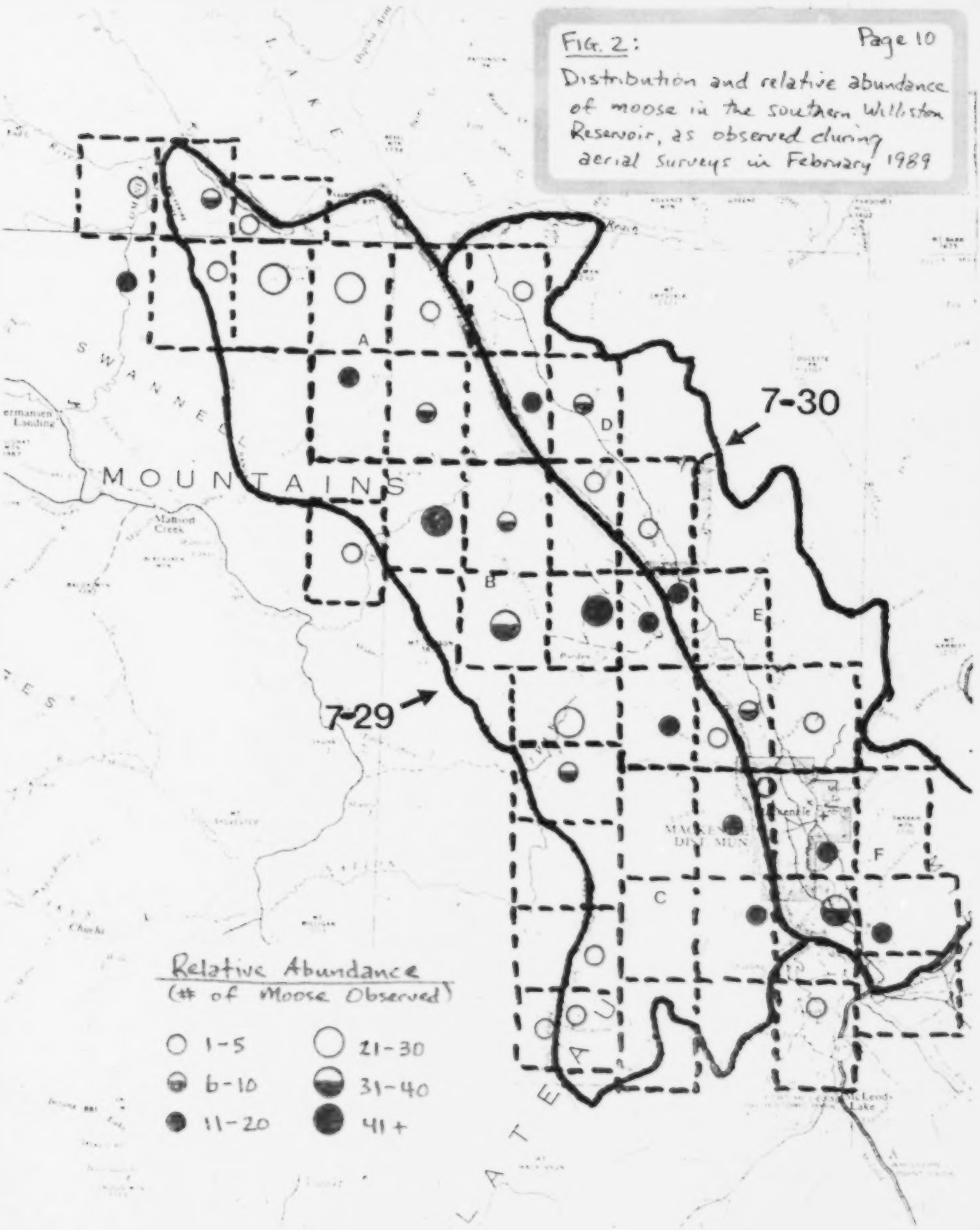


TABLE 2. DISTRIBUTION OF MOOSE, BY HABITAT TYPE AND ELEVATION, IN THE SOUTHERN WILLISTON RESERVOIR AREA, BRITISH COLUMBIA, FEBRUARY 1989.

HAB.[1]	GROUPS NO.	%	MOOSE NO.	%	MALES NO.	%	FEMALES NO.	%	JUV NO.	%	U-ADULT NO.	%	UNCL NO.	%	MEAN ELEV. (m)[2]
BU	2	1	4	1	0	0	2	1	2	3	0	0	0	0	725
CB	131	54	273	58	91	64	145	63	37	51	0	0	0	0	796
CT	17	7	29	6	5	4	11	5	10	14	3	19	0	0	779
MU	8	3	16	3	4	3	11	5	1	1	0	0	0	0	747
RS	14	6	27	6	14	10	11	5	2	3	0	0	0	0	764
RT	13	5	24	5	6	4	9	4	5	7	4	25	0	0	746
SU	4	2	9	2	2	1	5	2	2	3	0	0	0	0	1300
UC	27	11	47	10	7	5	16	7	10	14	9	56	5	71	757
UD	25	10	38	8	13	9	20	9	3	4	0	0	2	29	839
ALL	241		467		142		230		72		16		7		793

[1]Habitats:
- BU - Burn (where distinguishable from regenerating cutblocks).
- CB - Forest cutblock.
- CT - Timber immediately beside a forest cutblock.
- MU - Muskeg, bog.
- RS - Riparian shrub (mostly willow and/or alder).
- RT - Riparian timber (mostly cottonwood).
- SU - Subalpine (mostly balsam and/or deciduous shrub).
- UC - Upland conifer (dominated by spruce and/or pine).
- UD - Upland deciduous (dominated by aspen or birch).

[2]Elevation: taken from the helicopter altimeter for most observations on upland slopes and estimated from mapped locations in the flatlands; all estimated to the nearest 25 m.

at or below 775 m, i.e., within 100 m of the reservoir. Although there were a few higher occurrences (6% of both groups and animals), the upslope limit for occurrence of moose or recent sign over most of the area, regardless of habitat, was about 925 m (3000').

Snow Cover - As shown in Fig. 3, the snowpack varied considerably throughout the study area, with the greatest measured accumulation (about 90 cm) on the flat benches of upper Dastaiga and Tsedeka Creeks (M.U. 7-29). The only other measurement exceeding the 80 cm snow depth considered deleterious by Eastman (1977) was high on an east-facing slope overlooking the reservoir north of Nation Arm and, indeed, there was no moose sign in that area. Judging from observations of tracks and/or sinking depths of moose, a snowpack of 70-80 cm or more was the rule above 900 m elevation. Local snow depths on some of the steep west and/or south-facing slopes in the northern sections of M.U. 7-29 were reduced over those pertaining on the flat benches, even at much lower elevation. Snow depth was also less in some timbered areas. In the vicinity of Shoal Lake (M.U. 7-29), measurements of about 50 cm were taken riparian in shrub habitats at two different locations, but were only 30-35 cm in adjacent stands of rather thick pine.

4.4 Other Species

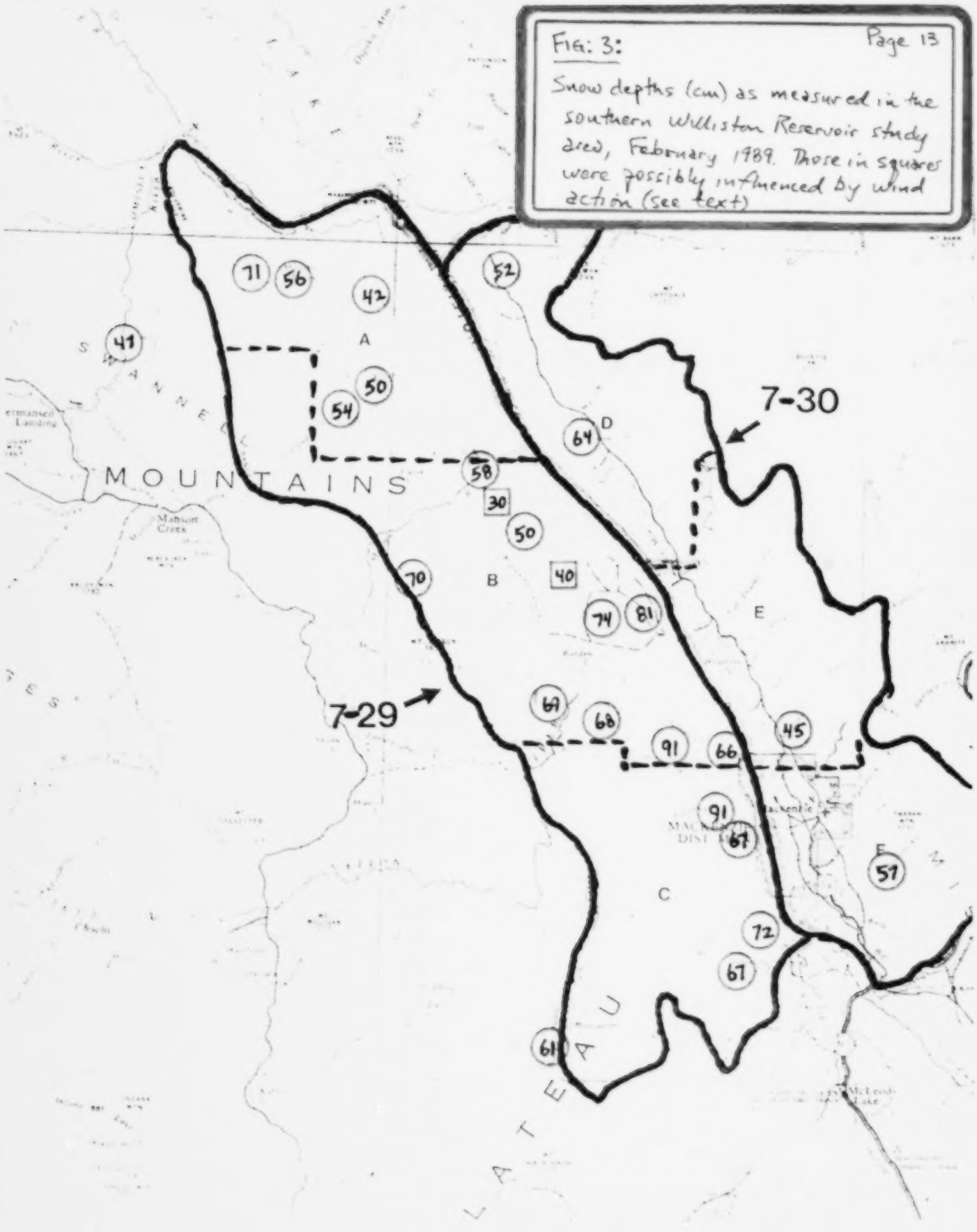
Appendix 1 lists and describes sightings of other (non-moose) wildlife and sign recorded during the February surveys. Following are summary statements for the major species identified.

Caribou - A total of 14 animals (groups of 10 and 4) were seen incidental to the moose surveys in forested lowlands of M.U. 7-29 (lower Blackwater - Manson Arm area), and 214 more were counted and classified in uplands of the Wolverine Range, along the boundary between M.U.'s 7-29 and 7-38 (see Appendix 5 and Fig. 5). In addition, helicopter pilot B. Dougherty (pers, comm.) reported that he had seen, earlier this winter, up to 6 caribou in and around the pine flats at the mouth of Scott Creek and about that number near the communications installation on Morfee Mountain (both M.U. 7-30).

Deer - A doe and fawn white-tailed deer were glimpsed in timber at the edge of a logging cutblock north of Strandberg Bay (M.U. 7-29), but no other white-tailed deer and no mule deer were observed during the surveys. There were apparently a few mule deer in the Burden Lake area, especially on the breaks above Nation Arm, as late as November this past fall (R. Quaedvlieg, pers, comm.) but no sign was evident there in February. Conservation officer S. Wasylik reported (pers, comm.) that 10-12 mule deer have been wintering in the industrial area northeast of the airport.

FIG: 3:

Snow depths (cm) as measured in the southern Williston Reservoir study area, February 1989. Those in squares were possibly influenced by wind action (see text)



Mountain Goat - Six animals, including a nanny with two kids, were observed incidentally during the caribou survey in the Wolverine Range (Appendix 5 and Fig. 5).

Stone's Sheep - Five, including two rams, were observed incidentally in uplands east of Finlay Bay, M.U. 7-30.

Wolf - A single black individual was glimpsed in the Nation River area (M.U. 7-29) and two young wolves (also both black) were seen in the valley of Mugaha Creek (M.U. 7-30). The only other record for the study period was of two heard howling during the evenings of 16 and 17 February by R. Quaedvlieg (pers, comm.), near his residence at Blackwater Creek. In general, we saw very little wolf sign throughout the survey, and no certain evidence of packs larger than 3 animals. Only three kill sites were located: one along the Nation River (7-29) involving a calf probably killed by wolves, one north of Robinson Creek (7-29) that had been visited by wolves but not necessarily killed by them, and one in uplands north of Nation Arm (7-29) at which only wolverine sign was seen. The relative absence of wolf sign might be explainable by the extreme dispersion of moose throughout the various upland habitats, rather than concentrated in lowlands. Thus, either the wolves have a harder time subsisting with the moose so dispersed or, more likely, they are less conspicuous than when their primary travel routes are along the rivers.

Other - The only other mammals seen were one coyote, one red fox, and several snowshoe hares. However, furbearer sign (tracks) were common throughout the area, with wolverine and river otter particularly conspicuous. Other furbearer tracks seen were marten (frequent), lynx (common), and a few fisher and mink.

5. DISCUSSION

Following sections focus on moose and moose habitat in the study area, in the context of mitigating/compensating winter habitat losses caused by the B.C. Hydro flooding.

5.1 Present Habitat Conditions

Bonar (1975) provided early verbal descriptions, assessments, and predictions for wildlife habitat use in the Williston Reservoir area. Those accounts are summarized and updated in Appendix 4. In general, the only significant changes in moose wintering potential throughout the study area have resulted from a combination of logging and ecological succession in upland habitats. That is, most wetland and riparian habitats in the area appear to have retained similar vegetation characteristics and extent of use

over the past 15 years. Drawdown and immediate foreshore areas of the reservoir have not improved and/or come into significant new production during that time period.

5.2 Enhancement Potential

A number of factors bear on the question of compensatory/mitigative habitat enhancement for moose in the present study area. It is beyond the scope of this project to develop that topic fully here, but I will raise a few points that have occurred to me during the course of the field studies and subsequent data analysis:

A) The existing moose population in the study area has developed and "adjusted" primarily in the post-flooding period. That is, few (if any) of the animals now present are among those that formerly had a tradition for winter movements to lowland winter habitats now covered by the reservoir. The nature and extent of local movements at the present time is not known, but there seems little point in enhancing habitats to which moose may not easily or readily come.

B) Overall, we noted no significant moose concentrations and identified no clearly over-utilized habitats needing rehabilitation. That fact may be a result of low moose numbers in relation to available habitat for reasons not directly related to habitat quality or quantity (predation, hunter kill, etc.), but may also reflect reduced pressure on the observed habitats during a series of relatively easy winters in previous years.

C) Some wetland and riparian habitats in the area are characterized by shrub growth that is older and higher than desirable for optimum moose forage production and availability, and could easily be enhanced by mechanical means. However, such areas may also be subject to future flooding, in the event of further raised water levels for Hydro development.

D) Further wetland enhancement projects such as that undertaken by Ducks Unlimited in the southeastern end of 15-Mile Swamp may have more value and validity for the proposal area than other kinds—we may not be able to substantially increase moose numbers with lowland habitat manipulations alone, especially with current limitations imposed by the reservoir. However, projects for waterfowl and aquatic furbearers are eminently visible, and will provide at least some local benefits to moose as well. On this point, it should also be noted that while logging is replacing some of the winter habitat lost to the reservoir, no other land use or management practice will replace lost wetlands.

E) Habitat enhancement suggests fostering animal <u>concentrations</u> in particular places, although the apparent present strategy of widespread dispersion may be more appropriate.

F) Enhancement possibilities within forest lands, such as by prescribed burns, would seem to be a less viable option in the area than simply protecting areas already enhanced by logging.

G) As outlined in the habitat section (4.3), forest cutblocks were by far the most intensively used habitats in the study area. I do not consider it likely that their present use by moose can be "replaced" by any scale of enhancement in the remaining non-forest areas. In short, if the local moose populations are to be managed for increases in numbers beyond those now pertaining (the normal goal of enhancement), that objective will not likely be met without the involvement and cooperation of the Forest Ministry, who has jurisdiction over the forest lands. Indeed, even maintenance of present numbers will be difficult in the face of increasing silviculture activity in the area.

5.3 Silviculture Implications

Although this topic is outside the present terms of reference, at least some consideration of it is required because of the extreme importance of forest cutblocks to moose in the area (Section 4.3). During the course of the surveys it became evident that some blocks were being used more by moose than others. It also became evident, through personal knowledge of cutblock history by the local trapper (R. Quaedvlieg, pers, comm.), that the absence or sparsity of moose use in some blocks may have been related to silvicultural activity in those blocks. For example, a recently thinned and spaced block near the Muscovite Lakes was trackless, while an adjacent, as yet untreated block contained 5 moose (including a cow w/ twin calves) and tracks of other species including numerous snowshoe hares, at least two lynx, and a fisher (from notes associated with observations 15 and 16 in Appendix 1).

To attempt to get a better feeling for this relationship, I solicited data on cutblock history for a series of blocks covered during the survey (see listing in Appendix 3). The comparisons that follow are very simple and preliminary, not considering the possible effects of intrinsic site differences in such features as elevation, exposure, the nature of adjacent habitats, and local animal numbers. Further, they consider only direct observations of animals at one point in time, not the nature and extent of activity as could be indicated by both tracks and sightings over a longer period. Finally, they involve only moose, although ultimately a number of other locally important wildlife species should also be considered (see Stevenson and Hatler 1988).

Moose are considered an "R-selected" species, adapted to find (through dispersal of young) and exploit short-lived, early successional habitats such as burns (see Geist 1971, 1975). Forest cutblocks fall in that category, and it seems apparent that the stage of vegetation development in each cutblock is related to age. As shown in Table 3, and consistent with expectations, the

TABLE 3. USE OF FOREST CUTBLOCKS BY MOOSE AS RELATED TO TIMING OF FORESTRY ACTIVITY[1], SOUTHERN WILLISTON RESERVOIR AREA, BRITISH COLUMBIA, FEBRUARY 1989.

A: COMPARISON BY CUTBLOCK AGE (YEARS SINCE LOGGING) ONLY.

	1-5 YRS		6-10 YRS		11-15 YRS		16+ YRS		STATISTICAL ANALYSIS[2]		
	NO.	%	NO.	%	NO.	%	NO.	%	X^2	df	p
With Moose	1	8	1	6	37	59	15	42			
W/out Moose	12	92	15	94	26	41	21	58	21.89	3	<.001
No. Cutblocks	13		16		63		36				
No. Moose	1		3		89		29				
Moose/block	0.07		0.19		1.41		0.81				

B: COMPARISON BY SILVICULTURE AGE (YEARS SINCE LAST TREATMENT)[3].

	1-5 YRS		6-10 YRS		11-15 YRS		16+ YRS		STATISTICAL ANALYSIS[2]		
	NO.	%	NO.	%	NO.	%	NO.	%	X^2	df	p
With Moose	6	16	8	32	32	60	8	62			
W/out Moose	31	84	17	68	21	40	5	38	20.48	3	<.001
No. Cutblocks	37		25		53		13				
No. Moose	10		17		80		15				
Moose/block	0.27		0.68		1.50		1.15				

[1]Logging and silviculture data from Ministry of Forests files, Mackenzie, B.C. This compilation represents a sample of cutblocks on NTS mapsheets 93 N/16, 93 O/11, 93 O/12, and 93 O/13 (see Appendix 3).

[2]Chi-square (X^2) analysis in 2 x 4 contingency tables (see Siegel 1956)

[3]Time, in years, since the last forestry activity in the area (including logging, but not fertilizing).

observed cutblocks in the present study area varied significantly with age in their apparent ability to support use by moose. Comparing lumped samples for (arbitrarily) 5-year periods, it appears that whether measured from the date of logging, or from the last silvicultural treatment, cutblocks in the age 1-10 years categories were relatively unproductive, while those at ages 11-15 supported the highest numbers of moose at the time of observation.

Table 4 compares moose occurrence in relation to a) early (within 2 years of logging) site preparation activities such as scarification and slash burning, and b) later brushing/thinning/planting treatments. Moose were found in untreated cut blocks significantly more often than in the treated ones (methods and extent of treatments not considered). Surprisingly, that was true even in the case of early treatments, which did not reduce the effective age of the blocks by more than a year or two.

The final comparison in this series is for presence or absence of moose in relation to incidence of the later, more intensive silvicultural activities within cutblock age categories (Table 5). As expected, the presence or absence of silviculture work in the younger cutblocks (age 1-10) made little difference, since moose can make little use of them in any case. The question of whether treatment of those younger blocks prevents them from attaining the more productive stages characteristic of the observed 11-15 years group cannot be answered or even speculated on with these data. Both of the older aged cutblock groups (11-15 and 16+ years) showed significant tendencies to reduced moose use in treated blocks. That result may simply reflect reduction in effective cutblock age (in terms of vegetation development), a condition that will be "corrected" in an appropriate number of years following. On the other hand, the effect may extend over the remaining life of the cutblock, i.e., eliminating it from the local inventory of winter moose habitat.

Overall, there are numerous unanswered questions in relation to both the short and long term effects of silviculture on moose habitat integrity in developing cutblocks. Some silvicultural procedures and/or timing may be less detrimental than others. For example, if silviculture were delayed until year 16 in a particular type of cover, would most of its benefits for moose already have been realized? The bottom line is that the objective of forest managers in conducting silviculture is to hasten the domination of a site by conifers, and that is in direct conflict with "Nature's" design for site regrowth on behalf of moose. Enhancement of moose populations in the southern Williston Reservoir is not likely a viable proposition unless that conflict is adequately addressed. That is particularly true now that silviculture is

TABLE 4. USE OF FOREST CUTBLOCKS BY MOOSE AS RELATED TO SILVICULTURE[1], SOUTHERN WILLISTON RESERVOIR AREA, BRITISH COLUMBIA, FEBRUARY 1989.

A: COMPARISON BY INCIDENCE OF EARLY SILVICULTURAL TREATMENT.

	ONLY EARLY TREATMENT		NO. SILV. TREATMENT		STATISTICAL ANALYSIS[2]		
	NO.	%	NO.	%	X^2	df	p
With Moose	10	40	29	78			
W/out Moose	15	60	8	22	7.84	1	<.01
No. Cutblocks	25		37				
No. Moose	27		66				
Moose/block	1.08		1.78				
Mean Cutblock Age	11.2		12.9				
Mean Silv. Age	10.0		12.9				

B: COMPARISON BY INCIDENCE OF LATER SILVICULTURAL TREATMENTS.

	WITH LATER TREATMENTS		NO SILV. TREATMENTS		STATISTICAL ANALYSIS[2]		
	NO.	%	NO.	%	X^2	df	p
With Moose	15	23	39	63			
W/out Moose	51	77	23	37	19.54	1	<.001
No. Cutblocks	66		62				
No. Moose	29		93				
Moose/Block	0.44		1.50				
Mean Cutblock Age	12.6		13.2				
Mean Silv. Age	7.3		12.8				

[1]Logging and silviculture data from Ministry of Forests files, Mackenzie, B.C. Early silvicultural treatment refers to site preparation by burning, mechanical, and/or chemical means, but all within two years of logging. Later treatments (more than two years after logging) include chemical and/or mechanical brushing and weeding, juvenile spacing, and planting (see Appendix 3).

[2]Chi-square (X^2) analysis in 2 x 2 contingency tables, with Yates' Correction (Siegel 1956)

TABLE 5. HABITAT USE BY MOOSE AS RELATED TO FOREST DEVELOPMENT HISTORY[1] (CUTBLOCK AGE AND INCIDENCE OF LATER SILVICULTURE TREATMENTS), SOUTHERN WILLISTON RESERVOIR AREA, BRITISH COLUMBIA, FEBRUARY 1989.

A: FOR CUTBLOCK AGES 1-10 YEARS (N = 29)

	WITH SILV. TREATMENTS		NO SILV. TREATMENTS		STATISTICAL ANALYSIS[2]		
	NO.	%	NO.	%	X^2	df	p
With Moose	0	0	2	7			
W/out Moose	17	59	10	34	1.00	1	<.50
No. Cutblocks	17		12				
No. Moose	0		4				
Moose/Block	0.00		0.33				

B: FOR CUTBLOCK AGES 11-15 YEARS (N = 63).

	WITH SILV. TREATMENTS		NO SILV. TREATMENTS		STATISTICAL ANALYSIS*		
	NO.	%	NO.	%	X*	df	p
With Moose	8	13	29	46			
W/out Moose	15	24	11	17	7.09	1	<.01
No. Cutblocks	23		40				
No. Moose	15		74				
Moose/Block	0.65		1.85				

C: FOR CUTBLOCK AGES 16 YEARS OR MORE (N = 36).

	WITH SILV. TREATMENTS		NO SILV. TREATMENTS		STATISTICAL ANALYSIS[2]		
	NO.	%	NO.	%	X^2	df	p
With Moose	7	19	8	22			
W/out Moose	19	53	2	6	6.33	1	<.02
No. Cutblocks	26		10				
No. Moose	14		15				
Moose/Block	0.54		1.50				

[1]Logging and silviculture data source and explanations as in Table 3. These comparisons are for the combined effects of silviculture and cutblock age.
[2]Chi-square (X^2) analysis in 2 x 2 contingency tables, with Yates' Correction (Siegel 1956)

attaining a higher public profile than previously, as evidenced by the requirement for "preharvest silvicultural prescriptions".

6. RECOMMENDATIONS

6.1 Forest Research

In my view, the outstanding need and opportunity in the southern Williston area is for a significant, continuing research effort to determine whether and how production of moose (and other wildlife) and forests can be combined. The need has been outlined in previous pages. The opportunity lies in the fact that there is a large assortment of different-sized and different-aged cutblocks available in a full variety of topographic, vegetational, and silvicultural contexts, and they (collectively) are apparently relied upon by a large proportion of the local moose population in winter. Further, a catalogue of cutblock histories is being prepared for the area (MOE Contract to L. Murray, Mackenzie). The situation is ideal for a study design involving random selection of treated and untreated cutblocks with selected characteristics, and monitoring them for both short-term and long-term comparisons of wildlife use. A series of graduate studies may be possible. Also in my view, although MOF funding should be sought, such research would be an appropriate expenditure for B.C. Hydro funding, since it focusses on producing moose in important remaining areas above the reservoir,

6.2 Potential Enhancement Projects

Notwithstanding the perceived long-term importance of forest lands in the local moose picture, and the acute need for applicable research as described above, there are some opportunities for at least small scale local enhancement projects in several non-forest areas. Such projects are needed both to maximize moose wintering potential in the area, and to demonstrate to forestry interests that not all wildlife management in the area is being conducted "at their expense". In all cases, the features of primary interest, in addition to apparently sufficient local numbers of moose to build from, are suitable interspersion of cover, winter foraging potential, and "accessibility" in terms of known or suspected movement corridors. Management priorities and specific plans should be established by MOE and local interests, in relation to local needs and regional objectives. Thus the order in the following list of potential enhancement areas is simply by M.U., from north to south, as depicted in Fig. 4, and annotations are in the form of descriptions and suggestions:

POTENTIAL MOOSE HABITAT ENHANCEMENT AREAS

MANAGEMENT UNIT 7-29

1) Shoal Lake Area: This is a lowland area (<800 m) with a considerable interspersion of small mixed forest (spruce, pine, aspen) stands and shrub meadows associated with a chain of both old and active beaver systems. The shrubs are generally high, and would benefit from a rehabilitation program, probably mostly by mechanical or manual means after freeze-up, but with a possibility of some burning.

2) Eklund Creek: Extensive shrub meadows in wet areas to the south of the lower creek appear to have good potential for mechanical rehabilitation.

3) Lower Manson River: Both shrub rehabilitation and some selective timber removal could provide for increased use of what appears to be the only "classical" river bottom wintering opportunity remaining in the southern Williston study area.

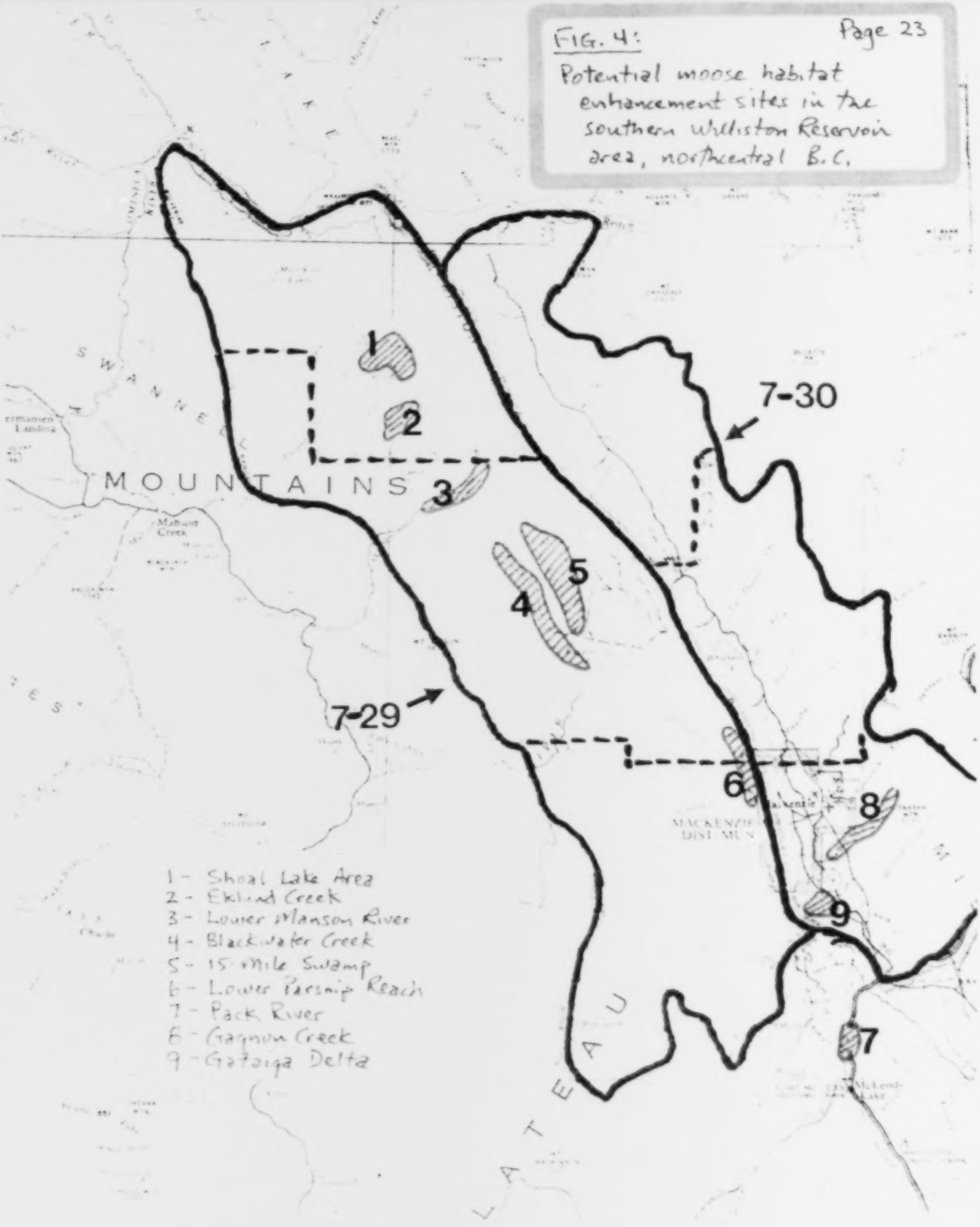
4) Blackwater Creek: This creek is characterized by a broad riparian shrub zone interspersed with wetland meadows and black spruce muskegs along most of its length. The shrubs are mostly high, and are candidates for mechanical rehabilitation on a segment-by-segment basis over several years.

5) 15-Mile Swamp: The potential for actual moose habitat enhancement in this area is unclear, but because it constitutes such a huge area of non-forest land, an aggressive program of experimentation seems warranted. The presence of old, filled-in beaver systems here and there in the open swamp area indicates that ponds, channels, and drier uplands were more common there in the past. Among the techniques that may contribute to greater habitat diversity and productivity in the area are channelization, local draining, blasting, burning, and planting of deciduous trees and shrubs. Undertaken in concert with a series of additional DU wetland projects, a 15-Mile Swamp enhancement program could develop into a major conservation achievement.

6) Lower Parsnip Reach: There are few non-forest areas of potential significance for wintering moose in the southern third of M.U. 7-29. Mechanical shrub rehabilitation is a possibility in some relatively extensive, mostly overgrown willow/alder thickets along the west shore of the reservoir across from Mackenzie

7) Pack River: Although outside the "official" study area, the upper Pack River is doubtlessly used by moose from the study area. The extensive shrub thickets on river bars and oxbows above Tudyah Lake would benefit from mechanical and/or manual treatment.

FIG. 4:
Potential moose habitat enhancement sites in the southern Williston Reservoir area, northcentral B.C.



POTENTIAL ENHANCEMENT AREAS (CONTINUED)

MANAGEMENT UNIT 7-30

8) Gagnon Creek: As with Blackwater Creek, above, though smaller in extent, the floodplain of the creek is fairly wide and supports a good cover of riparian shrub that would benefit from mechanical rehabilitation.

9) Gataiga Delta: There is an extensive muskeg and shrub wetlands area near the mouth of the creek, in which mechanical rehabilitation and possibly some burning would enhance moose wintering potential.

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APPENDIX 1. DETAILED REPORT ON AERIAL SURVEY RESULTS IN THE WILLISTON RESERVOIR AREA, FEBRUARY 1989.

Primary Purpose of Flights: Document winter distribution, aspects of abundance and population composition, and habitat status for moose in the study area.
Location: B.C. Ministry of Environment Management Units 7-29 and 7-30, adjacent to the reservoir. Reference to map numbers in the location column are to whole 1:50 000 sheets (National Topographic Series) and to sections (8.5" x 11") of those sheets as compiled in Appendix 6. For example, the entry "93 N/16 (5)" refers to whole mapsheet 93 N/16, and to map number 5 in Appendix 6.
Dates: Reconnaissance flight for planning on 10 February; surveys on 11-17 and 19-20 February 1989.
Weather: Mostly clear and cold (though sunny)--see descriptions under each date, below.
Aircraft: Bell 206, Jet Ranger, Northern Mountain Helicopters Ltd.
Pilots: 10th-17th, Bob Batchelor; 19th and 20th, Jim Franklin.
Observers: David Hatler, Robert Quaedvlieg, Ray Quaedvlieg, Steve Wasylik

Species Key:
M = Moose C = Caribou G = Mountain Goat Stone's Sheep = SS W = Wolf
D = Deer sp. WV = Wolverine 0 = Other species, as designated under remarks.

Classification:
M = male; F = female; J = juvenile (young-of-the-year); Y = yearling; U = unclassified; A = unclassified adult.

SUMMARY:

There had been little fresh snow over most of the study area during at least the previous 10 days, thus animal tracks had been accumulating for a considerable period. Tracks were therefore useful in delineating broad distributional characteristics of local populations, but were of little value for locating individual animals, especially in heavy use areas. Although air temperatures were not high during the study period, solar radiation was intense under the clear conditions pertaining and it is believed that many animals were seeking shade in timbered areas—moreso daily as the study progressed. Thus, not all animals in the area were seen. Following is a general summary of survey results, by species:

Moose - Total of 467 animals seen, of which 444 were classified to sex and age (adult or juvenile). That total includes 18 seen in adjacent management unit--14 in 7-38, 3 in 7-24, and 1 in 7-28. The moose data are summarized in Appendix 2, and discussed in considerable detail in the text.

Caribou - A total of 14 seen incidental to the moose surveys in forested lowlands of M.U. 7-29 (lower Blackwater - Manson Arm area), and 214 more counted and classified in uplands of the Wolverine Range, along the boundary between M.U.'s 7-29 and 7-38 (see Appendix 5).

Deer - A doe and fawn white-tailed deer were glimpsed in timber at the edge of a logging cutblock north of Strandberg Bay (M.U. 7-29), but no other white-tailed deer and no mule deer were observed.

Mountain Goat - Six observed incidentally during the caribou survey in the Wolverine Range.

Stone's Sheep - Five observed incidentally in uplands east of Finlay Bay, M.U. 7-30.

Wolf - One glimpsed in the Nation River area (M.U. 7-29) and two young individuals seen in the valley of Mugaha Creek (M.U. 7-30). Very little wolf sign was seen throughout the survey. Only three kill sites were located: one along the Nation River (7-29) involving a calf probably killed by wolves, one north of Robinson Creek (7-29) that had been visited by wolves but not necessarily killed by them, and one in uplands north of Nation Arm (7-29) at which only wolverine sign was seen.

Other - The only other mammals seen were one coyote, one red fox, and several snowshoe hares. However, furbearer sign (tracks) were common throughout the area, with wolverine and river otter particularly conspicuous. Other furbearer tracks seen were marten (frequent), lynx (common), and a few fisher and mink.

Overall, it was evident that local riparian habitats lost during the filling of Williston Reservoir have been replaced (as non-climax wildlife habitat) primarily by forestry cutblocks. Preliminary observations on this survey indicate that silvicultural activities may threaten the productivity (for wildlife) of those new habitats.

* * * * *

Note: For all moose observations recorded in following pages, summary data are given in parentheses, e.g., (3:1F,1J), where the number before the colon is the observation number, as shown on accompanying maps, and the information following the colon lists sex and age of the animals seen (one female with one juvenile in the above example) to facilitate the data compilation in Appendix 3.

Location	Species	Remarks
10 FEBRUARY: CLEAR. COLD. CALM		
General		Reconnaissance broadly around the perimeter of the study area: a few moose seen here and there in lower elevation openings (riparian shrub areas, bogs, and cutblocks); relatively little sign in most areas above 1000 m, but with local exceptions (e.g., 3 animals seen at about 1225 m on the east side of the Wolverine Range; few tracks in lowland (flat) cutblocks on the east side of the reservoir, but some sign evident in openings on the W and S-facing slopes in that area.
11 FEBRUARY: CLEAR. COLD. CALM		
Wolverine Range	C	Crossing range in shortcut to lower Omineca River, encountered tracks near timberline and then saw three groups, as follows: 10F,3J; 1M,2F,1J; 4F,1J. This observation is not shown on accompanying maps, since it almost certainly represents a duplicate sighting of animals seen and mapped on a subsequent day (see Appendix 5).
MAP IN APPENDIX 5 (FIG. 5)		
Blue Lake, Omineca Valley	M	A few tracks seen in wetlands around the lake, and scattered in spruce/aspen timber from there to the river.
Omineca River	M	On willow bars along the river: cow and calf (1:1F,1J), then five antlerless bulls (2:5M); downstream, cow and calf (3:1F,1J) in riparian habitat (cottonwoods with shrub understory).
	D	On steep, west-facing aspen slope--tracks that may be deer.
Omineca River	M	Three bulls (4:3M) in snow just up to their knees, in an oxbow beaver meadow; snow measurement there: 52,45,45 = 47 cm.
MAP NO. 94 C/2 (1)		
Farther downriver	M	Mostly conifer, with some aspen and with very little riparian habitat; only a few fresh tracks seen along the lower 15 km of river.
High slope over lower river	M	Two, probably cow and calf but only glimpsed and not found again (5:2U), seen at 925 m on a steep, SE-facing slope with abundant aspen; tracks common all along that slope.
Lower Omineca River	W	There was no wolf trail along the main river, but the track of a single animal was observed at the mouth of the Osilinka R.

Location	Species	Remarks
Osilinka River	M	Searched only the lower 3 km along the floodplain; a few scattered tracks seen.
MAP NO.94 C/1 (2)		
Omineca Arm		There are several un-named creeks draining into Omineca Arm from the NE slopes of the Wolverine Range; they are identified by Roman numerals (I-VI) on the maps, to facilitate note-taking; the general area is mostly thick spruce and pine, with occasional aspen and a few new cutblocks.
Creek No. I	O	Marten tracks along the creek and otter tracks at the mouth, but no significant moose habitat and no sign.
Creek No. II	M	As with Creek I, comes abruptly down a steep conifer slope; more pine and poplar and there are a few old moose tracks.
Creek No. III	M Wv	Some old moose tracks just up from the reservoir, and in deciduous patches (mostly aspen) at midslope; fresh wolverine track across the cutblock there and upslope.
Creek No. IV	M	There are some large patches of thick pine regeneration just to the east, but no moose tracks seen.
MAP NO. 94 C/1 (2-4)		
Creek No. V	O M	Wolverine tracks along the north fork (V-a); no sign on the middle fork (V-b), but there are several areas with moose tracks along the lower south fork (V-c), in open spruce/poplar with a good shrub (willow and alder) layer; a cow and calf (6:1F,1J) finally seen there.
Wolverine Range	M	The S-facing slope up V-c Creek is relatively open with lots of deciduous shrubs and low balsam; moose seen at three locations: three adults (7:1M,2F) at 1225 m, then two more (8:1M,1F) at 1375 m; cow and calf (9:1F,1J) on a slide area at 1375 m, at the head of the valley; there were fresh tracks to 1525 m in that valley, but the snow was deep--at least up to the tops of the animals legs (70-80 cm).
Strandberg Camp	M	Cow with twin calves (10:1F,2J) in thick pine regeneration at the mouth of the bay.
MAP NO. 93 N/16 (4-5)		
S. of Strandberg Camp	M	Another cow with twins (11:1F,2J) and a lone cow (12:1F) in a burn area upslope--good willow growth; many tracks.
Creek No. VI-a	O	Otter tracks and muskrat pushups at the small headwaters lake, but no fresh moose sign.

Location	Species	Remarks
Creek No. VI-b	M	Poorly defined, but apparently leading up to a narrow strip of muskeg; only a few old tracks.
Creek No. VI-c	M	A few tracks up to 975 m; two bulls (13:2M) seen at the upper edge of an old cutblock farther down the creek; lynx, marten, coyote tracks also seen in the general area.
	O	
Creek No. VI-d	WV	Up along the creek to about 1225 m; this is all thick conifer--no moose sign, but there are fresh wolverine tracks coming downslope and leading across a cutblock below; snow depth measured on a landing at about the break of the hill: 70,72,70 = 71 cm.
Creek No. VI-d area	M	Cow and calf (14:1F,1J) bedded in a small patch of spruce adjacent to the cutblock and south of the creek; some tracks from that pair out into the cutblock.
MAP NO. 93 N/16 (5)		
Muscovite Lakes	O	The westernmost of the lakes, SE of Creek VI-d;
	Wv	there are river otter and wolverine tracks all around both lakes and adjoining streams.
	M	Cutblocks in the vicinity of those lakes--one just SW was "juvenile spaced" last year and is presently trackless, although Robert Q. says that hares and moose were common there before; the blocks to the NW have not yet been treated, and are thick with moose, hare and furbearer tracks; five moose present in that block, including a cow with twins (15:1F,2J) and two adults (16:1M,1F); we walked through one edge of the block while the pilot went for
	O	fuel, and saw lynx tracks (at least two individuals), fisher tracks, and abundant hare tracks; the moose have been browsing mostly on willow and sapling birch, and are avoiding aspen and alder; comparative photos taken of the thinned and unthinned blocks.
BACK TO BLACKWATER FOR LUNCH		
MAPS NO. 94 C/1 (3)		
Strandberg Camp area		Back out after lunch, and starting east of the bay.
MAP NO. 93 N/16 (5)		
	M	Two bulls (17:2M) seen just east of camp.
MAP NO. 94 C/1 (3)		
Muscovite Lakes	M	Some old tracks in a partly flooded area to the north.
	W	Single set of wolf tracks along the beach.

Location	Species	Remarks
MAP NO. 93 N/16 (5.6)		
Muscovite Lakes	M	Winding down along deciduous ridges and a chain of lakes--looks like excellent habitat, but relatively little sign; Note: the pilot reports that he saw "several" moose here, especially cows with calves, in June last year; only three moose seen this time; two adults (18:1M,1F), and one bull (19:1M).
	O	Some fur sign, especially river otters, noted along some of the lakes.
Strandberg Crk	WV	Up north fork, into the mountains (1075 m); all conifer, and only furbearer tracks seen including 1 wolverine and several marten; farther down the creek, relatively little good
	M	riparian habitat and little sign; a cow moose (20:1F) finally seen in a streamside bog.
MAP NO. 93 N/16 (6)		
Strandberg Bay area	D	Two white-tailed deer (doe and fawn) glimpsed in timber at the edge of a cutblock north of Strandberg Bay; snow depth in that block was
	M	40,42,43 = 41.7 cm; a few moose tracks seen.
MAP NO. 93 N/16 (6) - 93 O/13 (7)		
Strandberg Bay	M	On peninsulas and points south of the bay, many areas have been flooded, but even those not flooded, and with apparent good cover and forage, are curiously trackless.
MAP NO. 93 O/13 (7)		
Across Manson Arm	M	Lots of tracks in the woods along the north end of the peninsula; three adults (21:2M,1F) seen in the shrub meadow at the extreme north end; both bulls had forkhorn antlers.
MAP NO. 93 O/13 (7.10)		
Manson Peninsula	M	Tracks are fairly common and there are some good shrub meadows along the upper east side, but most animals are apparently in adjacent timber--only one more (22:1M) seen; there is potential for some mechanical enhancement of shrub growth in these areas, especially on the north end.
MAP NO. O/13 (11)		
Manson Peninsula	M	Continuing down the east side--poorer habitat, with more conifer (mostly pine) and little riparian shrub; few tracks and no moose seen.
	C	Cratering seen in pine areas adjacent to several new cutblocks at the south end, and 10 caribou (7A,3J) seen.
MAP NO. 93 O/12 (15)		
Blackwater Arm	M	Occasional moose tracks along the west side of the Arm; cow and calf (23:1F,1J) seen at the edge of a cutblock near the head end.

Location	Species	Remarks
Blackwater Arm	C	On the peninsula to the east, caribou tracks and craters are common in pine uplands, and a few moose tracks are evident in mixed forest along the east side.
	M	
MAP NO. 93 O/12 (15.16)		
SE of Blackwater Arm	M	Cutblocks along the northern edge of prominent uplands east of the lower Blackwater show good cover and forage; tracks are abundant, but only 2 cow/calf pairs seen (24,25:2F,2J); only
	O	otter tracks along the creek to the south.

END OF DAY.

12 FEBRUARY 1989: CLEAR, COLD, CALM.

MAP NO. 93 O/12 (18)		
Blackwater Crk.	M	From Quedvlieg's downstream: good, extensive shrub meadows with both willow and alder (many of the shrubs are high, and there appears to be good potential for mechanical rehab, work).
	M	Cow and calf just northwest (26:1F,1J).
	M	Much of the surrounding area is a black spruce muskeg, still with good shrub cover; most tracks appear older.
	M	Cow and calf (27:1F,1J) at the edge of timber in road-straddling cutblock east of the creek.
	M	Single cow (28:1F) seen in the next cutblock to the north.
	O	Otter tracks along the creek.
	M	Cutblocks are both thinned and unthinned in this general area, and moose and furbearer sign is rare in the thinned blocks.
	M	Cow and calf (29:1F,1J) in timber at the edge of a cutblock.
	M	Two cows (30:2F) in a black spruce bog area--many tracks and good forage shrub cover here.
	M	Tracks are generally common to abundant in shrub meadows all along the creek, but most animals appear to have moved into adjacent timber.
MAP NO. 93 O/12 (15)		
Blackwater Crk.	M	Cow and calf (31:1F,1J) in thick spruce/alder on a western branch of the creek.

Location	Species	Remarks
Blackwater Crk.	M	Fresh tracks present both in upland forest and shrub meadow habitats along the creek, but no animals seen.
	M	Tracks less common farther downstream, where the shrub cover is less and/or lower; a snow measurement in an open, probably somewhat windswept meadow was 30,28,31 = 29.7 cm.
Manson River	0	Ground investigation of a disturbed area near the mouth indicated that a wolverine had dug out a dead beaver; coyote, fox, and mink tracks also present there; snow depth on the adjacent river bank was 58,55,61 = 58 cm.
Lower Manson R.	M	Cow and calf (32:1F,1J) seen in thick shrub cover on an oxbow just above the river mouth.
	M	Tracks common in riparian shrub habitats along the river, but most animals apparently in adjacent timber at this time; forest is spruce mixed with cottonwood along the river and with pine and aspen farther upslope.
	0	One Northern Dipper seen at a patch of open water.
MAP NO. 9? 0/12 (14)		
Below lower bridge	M	Two cows (33:2F) and a cow and calf (34:1F,1J) seen in separate cottonwood stands.
Above the bridge	M	Tracks common in riparian habitats and in upland forest for the first 5-6 km, but no more animals seen; relatively fewer tracks, mostly older, farther upstream.
MAP NO. 93 0/12 (13)		
Upper Manson R.	M	A few old tracks along the river.
MAP NO. 93 0/12 (-. BELOW 14)		
	M	Cutblocks upslope to the east show some fresher tracks, and one bull (35:1M) seen at 1225 m; snow depth nearby was 65,71,73 = 69.7 cm.
MAP NO. 93 0/12 (13)		
Upper Manson R.	M	Old cutblock at 900 m, east above the upper bridge, one lone cow moose (36:1F), then a cow and calf (37:1F,1J) a bit farther downslope.
MAP NO. 93 0/12 (14)		
	M	Old cutblock, 1075 m, cow w/ twins (38:1F,2J).
	0	Wolverine tracks upslope, north of the upper bridge.
	W	Note: No wolf trail seen anywhere along the Manson River.

Location	Species	Remarks
MAP NO. 93 O/12 (14)		
North of Upper Manson bridge.	M	One fresh track at 1075 m; the moose was plowing through deep snow, and the track appeared as a long furrow.
Curve Lake area	0	Wolverine track upslope to the west.
	M	Old, unthinned cutblock NE of Curve Lake, four adult moose (39:2M,2F); one of the bulls had both forkhorn antlers when first observed, but dropped one while running from the helicopter.
	M	Next cutblock to the south, three more adult moose (40:2F,1M).
	M	Big cutblock to the NW--lots of willow showing; cow and bull (41:1F,1M), then a cow and calf (42:1F,1J) near the upper edge.
MAP NO. 93 O/13 MO)		
	M	Next occupied clearcut--single bull (43:1M), then a cow and bull (44:1F,1M), then another lone bull (45:1M).
MAP NO. 93 O/12 (14)		
	M	Next cutblock south, cow and calf (46:1F,1J).
Curve Lake	M	Upslope to west of the lake (off map 14), no deciduous growth and no tracks; back along the drainage below the lake--a few tracks (probably made by a single animal) seen up the stream branch to the south and one cow moose (47:1F) found at the edge of a cutblock south of the fork.
S. of the Manson	M	Three moose (48:1M,1F,1J) seen just into the timber SE of the lower Manson Bridge.
END OF MORNING FLIGHT (12TH): BACK TO BLACKWATER FOR FUEL AND LUNCH.		
MAP NO. 93 O/12 (15.14)		
Manson Arm, W. side	M	Start 12th pm; large block of uncut forest here is mostly pine, but with patches of spruce and occasional aspen; tracks present in shrub meadows along the edge of Manson Arm, but no animals seen.
MAP NO. 93 O/13 (10)		
Manson Arm	M	On the west and interior of the peninsula, near the southern end there are large expanses of deciduous cover, both birch and aspen, and there are fresh moose tracks throughout, but no animals seen.
	0	Several osprey nests seen on emergent snags along the west side of Manson Arm.

Location	Species	Remarks
S. of Eklund Bay	0	First major creek south, flood influence goes well up the drainage and there is little riparian habitat remaining; no tracks except the meanderings of a river otter.
	0	One Northern Dipper seen at the mouth of a small stream (open water) S. of Eklund Bay.
Eklund Crk.	M	Along the south branch, from Eklund Bay, a few moose tracks but the remaining riparian habitat is marginal; a few tracks seen in shrub meadows to the west.
Eklund Crk. Area	M	Three cow moose (49:3F) seen in a small willow swamp at the head of the north branch from Eklund Bay.
	M	Little sign along the main creek; swamps and meadows to the south have a good shrub component, and there are occasional tracks; the shrubs are high, and enhancement by mechanical means is a possibility here.
MAP NO. 93 N/16 (9)		
Eklund Crk.	M	One cow and calf (50:1F,1J) seen in a sparsely timbered bog west of the main wetland area.
	M	In a cutblock just north of the creek, 3 adults (51:2M,1F), and a cow and calf (52:1F,1J), then, in the cutblock across the creek to the south, four more adults, all bulls (53:4M).
Upper Eklund Crk.	0	There are numerous large, new cutblocks, which may presently interfere with up and downslope movements to the Eklund drainage; the extreme upper section of the creek, in the mountains (all branches), is primarily conifer cover--good marten habitat but of limited value to moose; snow depth at about 850 m in a cutblock along the north fork was 52,54,55 = 53.7 cm;
	Wv	one fresh wolverine track at that location.
Shoal Lake area	M	Cutblocks to the SE, four adults (54:3F,1M) in the largest; fresh tracks in two of the three others, and in riparian habitat at the SE corner of Shoal Lake proper; the lowlands to the NE of the lake show extensive beaver systems and shrub meadows, with tracks common and with considerable enhancement potential;
	0	one coyote seen bedded down on a beaver house in this area.
MAP NO. 93 N/16 (6.5)		
Fries Crk. area	M	Several old cutblocks (unthinned) along low ridges north of the creek--sightings in

Location	Species	Remarks
		each as follows: two (55:1F,1J) + two (56:2F); tracks only; one (57:1M) + two (58:1F,1J) + one (59:1M); two (60:1F,1J) + two (61:1M,1F); two (62:1F,1J) + five (63:2M,3F) + three (64:3F)--both bulls were antlered, one with a single forkhorn and the other with palms and a spread of about 75 cm; two + two (65:2F) and (66:2F); two (67:1F,1J); only a few tracks in the last block (near the reservoir).
TO FINLAY BAY FOR FUEL.		
MAP NO. 93 0/13 (8)		
Finlay Bay area	M	Some deciduous cover along the slope to the north, but few tracks; one set of fresh tracks at about 1250 m.
	SS	Three ewes in a low, windblown saddle west of Mt. Selwyn.
	M	Only a few old moose tracks along Finlay Bay and no significant sign along the west side of the peninsula in that area, or in adjacent lowlands; 5 adults (68:3F,2M) found at about 975 m on the west-facing, aspen-covered slope.
Canty Crk area	SS	Two Class IV rams seen on exposed rocky bluffs well below timberline (about 1225 m).
Lowlands to south	M	Little sign in cutblocks and shrub meadows in this area; a few fresh tracks seen on the west-facing slope at about 850 m, but no more animals seen.
END OF DAY.		
13 FEBRUARY 1989: CLEAR. COLD. BUT WITH LOCAL FOG.		
Reservoir area	0	Attempted to get out to survey area at 08:30, but failed; saw 1 Goshawk and 1 red fox along the shore across from Mackenzie.
Blackwater area		Managed to get out of town at 11:20, and we will again be conducting the surveys in clear, sunny conditions; enroute, the pilot glimpsed
	W	a black wolf crossing the road a few km south of the Nation River bridge.
MAP NO. 93 0/12 (19)		
NW of Burden Lake	M	Very large cutblocks with good deciduous growth and abundant tracks; first moose seen were a cow and calf (69:1F,1J), then a lone bull (70:1M); tracks in the area suggested that there were many more animals than that.

Location	Species	Remarks
Nation Arm Area	M	Along the bench on the north side of the Arm, tracks are common in old cutblocks and in mixed forest cover; finally found a bull with one 3-point antler and a cow (71:1M,1F), and then a bull with a 2-point antler (72:1M).
MAP NO. 93 O/11 (20)		
Nation River	M	Into cutblocks whose recent history is known by Robert Q.; the first small block just south of the main haul road was sprayed (2-4-5-T?) a few years ago--only a few old tracks seen there; the block above the road in that area had fresh tracks, while another higher block that was thinned and spaced last year had no tracks; a few tracks seen to about 875 m at the edges of cutblocks, but the first animals found in this general area were below the road--a cow and calf (73:1F,1J) and a single cow (74:1F) in thick cover between blocks.
N. of Nation Arm		Into hilly country with numerous cutblocks; blocks south of Maybeline Lake have good cover and forage, but are apparently too high (most about 925 m), and there is little sign of recent use by moose.
Maybeline Lake uplands	M	One cow (75:1F) seen at the lower end of a cutblock where tracks were fairly common; relatively little sign in the area as a whole, especially in blocks on the slope facing east, toward the reservoir--many of those have undergone recent silvicultural treatment.
E-facing Slope	M	Tracks in a few blocks, but no animals seen; snow depth on the ridge (925 m): 80,78,84 = 80.7 cm; most--blocks in this area have been cleared of deciduous cover, thus both snow depth and forage are probably limiting here.
Lower Slope	M	Only a few tracks in cutblocks and on the road just above the reservoir (5 km section).
MAP NO. 93 O/12 (19)		
Christine Lake	0	One old beaver lodge and a few muskrat push-ups.
Christine L. area	M	Huge cutblocks--many new and/or recently "rehabilitated" for silvicultural purposes; little sign of wildlife.
N. of Head Lake	Wv	Old moose kill, regularly visited by a wolverine but no other recent sign, and cause of death not determinable.
W. of Head Lake	M	Three adults (76:3M), then two (77:2F) in the first cutblock to the northeast.

Location	Species	Remarks
Farther north	M	Cow and calf (78:1F,1J) in an older cutblock that appears as an "island" of vegetation; this is an immense clearcut area, and I am having some trouble navigating here.
SW of Christine Lk	M	Cow (79:1F) with an apparent crippled front leg seen in an upland willow swamp.
E. of 15 Mile Swamp	M	Cutblocks on the swamp (west) side of the upland are older and mostly untreated, and we're back into regular moose tracks; cow and calf (80:1F,1J) seen at 925 m.
Farther NW, same uplands	M	Several moose seen, as follows: two (81:1M,1F); nine (82:4M,5F--2 bulls each with 1 forkhorn antler, 1 with a spike antler, and one with antlers both shed); one (83:1M, with a forked antler); one (84:1M); one (85:1F); two (86:1F,1J--in an older clearcut).
Farther South, same uplands	M	Still seeing abundant sign and occasional animals: two single animals seen in creek bottom shrub meadows (87:1F, 88:1M), then up to the NE--a cow and calf (89:1F,1J) in thick timber along a narrow ridge; mostly ran out of tracks at 925 m, where snow depth was measured at 70,78,74 = 74 cm.
N. of Burden Lake	M	One bull (90:1M) in creek bottom shrub meadow leading south from the uplands NE of the lake, then two bulls (91:2M) on a knoll at the edge of the timber to the south.
	M	Cow and calf (91:1F,1J) on a timbered knoll SE of the DU project area.
END FLIGHT FOR FUEL RUN.		
MAP NO. 93 0/12 (18)		
W. of Blackwater	M	Tracks common and several moose seen in upslope cutblocks west of Quaedvlieg's place: cow and calf (93:1F,1J) on a spur road between two cutblocks; three adults (94:2F,1M with both antlers--forkhorn) in upper block; cow and calf (95:1F,1J) in next block; low block (about 750 m) just above the main haul road, three (96:2F,1M--yearling); at the edge of the next block, four adults (97:3F,1M--one of the cows got hung up in a windfall for several minutes); at the top of that block, two singles (98:1M, 99:1F); ran out of tracks at about 925m in most blocks in this area; below (east side) of the main road, one cow (100:1F) and many tracks seen at the edge of a cutblock

Location	Species	Remarks
		with nice deciduous cover; two bulls (101:2M) at the edge of a shrub meadow farther east.

END OF DAY.

14 FEBRUARY 1989: LOCAL SNOW AND CLOUD IN A.M., BUT CLEAR AND COLD LATER.

MAP NO. 93 0/11 (20) - 0/6 (23)		
S. Side Nation Arm	M	Starting at the mouth of the Arm and working west; saw a few local concentrations of tracks from there to the bridge, but cutblocks in this area have little forage and there is not much riparian habitat remaining.
MAP NO. 93 0/6 (23)		
West of Nation bridge	M	A few tracks at the edges of cutblocks and in small patches of riparian-like habitat along the present lake shore; 1 adult glimpsed in thick spruce along a creek (102:1A).
MAP NO. 93 0/5 (22)		
Nation River	M	No significant riparian habitat in lower few km; the only tracks seen were on a pine/aspen bench well upslope.
	M	Another bench above the river--one cow (103:1F), and sufficient tracks to suggest that other moose were also present in the area.
MAP NO. 93 0/5 (26)		
Nation River	M	To the M.U. boundary along the southern shore; relatively little sign over most of it.
	M	Over to the south-facing slope--nice looking series of benches with general pine/aspen cover--two cow moose (104:2F) seen at 875 m, and tracks to 1050 m; the snow appears shallow on this fairly steep slope--not up to the knees of the moose observed; cow and calf (105:1F,1J) seen at 800 m.
MAP NO. 93 0/5 (22)		
Farther north along Nation R.	M	Tracks to 1100 m in the drainage basin to the NW of where the cow and calf were seen, but the next animal is a bull (106:1M) way down at 800 m.
	0	Moose tracks are common along most of this slope, especially on aspen benches, and there are numerous furbearer tracks in the high mixed-forest basins--hare, lynx, and marten tracks seen in one opening.
Nation uplands	M	Two cows (107:2F) seen on a prominent knoll at 950 m; snow depth there appeared to be only 30-40 cm, but was 65,70,72 = 69 cm on a beaver pond just downslope (925 m) to the north; extensive areas of birch and willow

Location	Species	Remarks
		upslope from that--some potential for enhancement, although probably too high.
Nation River	M	Farther upstream, tracks common on knolls at 850 m, but the next animal seen (108:1F) was on a ridge just above the river (about 700 m).
Nation River	M	More tracks on aspen benches to the north, and two adults (109:1M,1F) seen at 750 m on one of those, and a lone cow (110:1F) on an aspen-covered knoll just upstream.
Blackwater Lk area	M W	On a small lake just south, remains of a calf moose (not a recent kill); a single wolf has been here recently, and one or more coyotes; older wolf tracks in the area suggest that a small pack may have made the kill.
Nation River	D	Along the bench above the river, south of Burden Lake; Robert Q. advises that he has seen deer in this general area earlier in the winter, but no tracks in evidence now.
Burden Lake area	M	One small bull (111:1M, forkhorn antlers) seen at the edge of the cutblock just to the SE, still on the bench above the river.
MAP NO. 93 0/11 (20) Nation Arm	M	No significant riparian habitat remaining below the bench, although there are old tracks leading down the steep slope to the shore at one location.
	M	Cutblocks upslope from the mouth of the Arm: no moose and only a few old tracks in a block that has been reportedly been treated with herbicide (R.Q.); 10 moose in the next (untreated) block to the east, as follows: two (112:1F,1J); three (113:2F,1M); two (114:2F); three (115:2F,1M).
	M	Easternmost cutblock on the north side of the Arm--a few tracks, but no moose seen.
MAP NO. 93 0/5 (22) Burden Lake area	M	Back to the SW end of the lake; two bulls (116:2M) at the south edge of a cutblock and one more to the north (117:1M).
MAP NO. 93 0/12 (19) W. of Burden Lake	M	Two bulls and a cow (118:2M,1F) in shrub habitat at the edge of a large cutblock.
MAP NO. 93 0/5 (22) Blackwater Lake Area	M	A single cow (119:1F) seen in a block just north of the lower end of the lake.

Location	Species	Remarks
	M W	A few tracks across the shrub meadow at the head of the lake, but no animals seen; there is no heavy wolf trail in this area, but a a single animal crossed the upper lake--it was probably the same one that visited the kill just to the south.
W. of Blackwater	M	Cutblocks west of the lake: one bull (120:1M) just into timber at the low edge of the first block; only old tracks higher up there, and in adjacent blocks; these may be too high at this exposure.
Farther NW	M	Abundant tracks in shrub meadows beside some small lakes NW of Blackwater Lake, but no animals seen.
Upper Blackwater Creek	O	Numerous otter tracks in wetlands below the main lake.
MAP NO. 93 O/12 (19)		
Upper Blackwater	M	Three moose (121:3F) in wetland shrub habitat beside a cutblock just east of the creek.
END OF MORNING FLIGHT (14TH)		
MAP NO. 93 O/12 (15)		
SE of Blackwater Arm	C	3 bulls and 1 antlerless cow caribou seen in thick pine (in passing).
MAP NO. 93 O/13 (8)		
S. of Finlay Bay	M	Starting afternoon surveys: no tracks in lowlands, but there was one area of recent use by one or more animals along the creek at the upper edge of the highest cutblock in this area (875 m); good deciduous cover higher upslope, but no sign.
MAP NO. 93 O/13 (11)		
N. of Weston Arm	M	On the peninsula where several cutblocks are proposed, there is some good shrub meadow and upland mixed forest habitat, but only a few old tracks observed; cutblocks upslope north of Weston Arm--two cows (122:2F) seen at the upper edge of the highest (1000 m), and fresh tracks lower down, below the road; large expanse of contiguous cutblocks upslope have what appears to be good cover, forage, and exposure so the almost complete absence of moose and sign is puzzling.
Drainage N. of Weston Crk	M	Tracks appearing again at 925 m, and then several moose seen in blocks downslope, as follows: one (123:1F); three (124:2F,1M); two (125:2F).

Location	Species	Remarks
Weston Crk	M	More moose in cutblocks up from the creek: one (126:1M); three (127:2F,1M with forkhorn antlers); one (128:1M).
S. of Weston Arm	M	The large cutblock starting at the point on the south side of the Arm has been dozed into a pattern of windrows and there are few tracks among the remaining forage and cover; cow and calf (129:1F,1J) seen just up from the reservoir, and a single cow (130:1F) at the edge of a depression to the south.
MAP NO. 93 0/13 (12.11)		
Lower Weston Crk	M	Back up to a cutblock beside the creek--one bull (131:1M) at the edge of the timber, and then two animals glimpsed in thick timber (132:2U).
MAP NO. 93 0/13 (12)		
Weston Creek	M	Back south to a large block south of the creek--three adults (133:3F).
	M	One cow and calf (134:1F,1J) seen in thick woods along the creek well upstream; tracks seen a few km farther up, but no more animals.
Weston Crk. Area	M	Cutblocks on NE-facing slope along creek, a few tracks at lower edge; snow depth at 900 m in that area: 62,64,65 = 63.7 cm; that was above the zone of track occurrence in this area, and only a few old tracks seen lower down.
MAP NO. 93 0/12 (16)		
N. of Scott Crk	M	The west slope of the upland between Scott and Weston Creeks has some excellent looking deciduous cover and there are numerous tracks, but no animals seen.
MAP NO. 93 0/13 (12.11)		
Weston-Scott upland	M	The three old cutblocks just above reservoir level on the Weston end of this upland have a good mix of open conifer and deciduous cover and are heavily tracked, but only two moose seen, (135:1F) in the S block, and (136:1F) in thick timber adjacent to the middle block); shrub growth in and adjacent to these blocks is high, and enhancement is a possibility.
N. of Scott Creek	M	There are deciduous patches just up from the reservoir in several locations, but only a few tracks seen.
MAP NO. 93 0/12 (16)		
Scott Creek	M	The flood influence has gone well up the creek and there is little significant riparian habitat below the road crossing and only a few old tracks upstream; one bull (137:1M) seen on the south point at the mouth of the creek.

END OF DAY (14TH).

Location	Species	Remarks
15 FEBRUARY 1989: CLEAR. COLD. WITH MODERATE TO GUSTY WINDS.		
MAP NO. 93 N/16 (5)		
Strandberg Crk	M	Picking up some old cutblocks not done earlier: good aspen and willow cover, and numerous tracks in the first block--2 single moose (138:1M, 139:1F) at the north end; abundant tracks (moose and hares), and three moose (140:2F, 141:1M) seen in the next block north; 3rd block, scheduled for thinning--
	0	abundant hare tracks and one seen, and lynx, coyote, and marten tracks; block 4, thinned and spaced last summer, has no tracks of any kind--comparative photos taken of both; snow depth in block 3 was 53,60,55 = 56 cm.
MAP NO. 93 O/12 (15)		
15 Mile Swamp	M	Working in zig-zag pattern from the mouth of Blackwater Creek southward; a few tracks in shrub meadows at the bottom (north) end, and snow depth was 50,50,51 = 50.3 cm in a relatively protected location beside a small "island" of spruce; the willows here are high and could be enhanced by mechanical treatment.
	0	Several furbearer tracks around beaver systems in the area, especially lynx and river otter, but also wolverine, marten, and coyote.
MAP NO. 93 O/12 (18.19)		
15 Mile Swamp	M	The main swamp is low shrub, apparently mostly arctic birch, and the only tracks are along the edges--some fresh enough to suggest that the animals were not far into adjacent timber;
	0	there are several old beaver dams--some very large--showing on the open flats (photographed one about midway along); snow measurement at the edge of the flats, probably reflecting effects of wind action: 39,40,40 = 39.7 cm.
DU Project area	M	Numerous moose tracks, but no animals out in the open at this time.
N. of Blackwater Lake	M	Completing coverage of upper Blackwater Creek; low cutblock NW of the lakes has some fresh tracks, but there are none above 875 m in this area.
Upper Blackwater Creek	M	Good shrub meadows among spruce bog in the upper creek basin; numerous tracks and three animals seen (142:2F, 143:1M), all in thick black spruce cover adjacent to the open shrub areas; also many tracks in an adjacent cutblock.
MAP NO. 93 O/12 (18)		
	M	Cutblocks to west--tracks in all, and four animals seen in one (144:2F, 145:2M).

Location	Species	Remarks
ABOVE: END OF MORNING FLIGHT (15TH)		
MAP NO. 93 0/12 (16)		
S. of Scott Crk	M	Starting pm flight along the reservoir shoreline, good deciduous cover (photo taken) and moose tracks common, but no animals seen; trees were mostly aspen to the north (Scott Crk), but birch takes over a few km down the reservoir.
Yahwa Crk area	M	Fresh tracks fairly common along the drainage south from the upland west of the creek, and up to 975 m in a cutblock on the S-facing slope, but the Yahwa Creek bottom itself was trackless (although appearing to have some suitable habitat).
MAP NO. 93 0/11 (17)		
Inati Crk	M	Fresh tracks at 950 m on the south point of the valley, but no animals seen.
West of Yahwa Crk		Good, W-facing deciduous slope, but no tracks until the drainage south of Lattah Crk, and those old.
Kimta Creek	M	Lovely open deciduous slopes on both sides of the creek, and tracks present; cow and calf (146:1F,1J) seen at 1225 m, well up the creek, and tracks indicate that they have been there for weeks--though snow is deep (chest furrow in their tracks); other tracks to 1375 m in this general area and up to 1075 m on the N-facing side of the valley.
South	M	Small tributary of Six Mile Creek between Kimta and Patsuk Creeks, good deciduous (aspen) cover on the S-facing slope, and tracks of at least one animal present there.
Six Mile Creek	M	Some suitable riparian habitat, but no tracks.
	M	One cow moose (147:1F) seen at 900 m on the W-facing slope over the reservoir; tracks seen in most cutblocks W of lower Six Mile Creek.
MAP NO. 93 0/11 (20)		
Lower Six Mile Crk	M	Many tracks in cutblocks; cow with twin calves (148:1F,2J) seen in one by the inlet in that area; blocks upslope and/or to the west (including Patsuk Creek--Map 17) show mostly only old tracks; one lone cow (149:1F) seen in a wetland thicket between two cutblocks north of Lamonti Creek; given the expanse of deciduous slopes in the general vicinity of Six Mile Creek (both east and west), I would have expected more moose and sign.

Location	Species	Remarks
Lamenti Creek	M	Fresh tracks of one animal at the south end of a cutblock along the lower end, but that animal apparently in the adjacent timber; one adult (150:1A) ducked into timber from the edge of a cutblock at the mountain base.
West of road	M	Interesting topography between Lamonti and Cut Thumb Creeks, with numerous sinkholes and ridges; incomplete coverage, focussing on cutblocks located six moose in that area: two (151:1M,1F) in a cutblock near the road; two (152:1F,1J) on a trail just above the reservoir; two (153:1M,1F) among numerous tracks in the cutblock nearest Cut Thumb Crk.
MAP NO. 93 0/11 (21)		
Cut Thumb Creek	M	Long flight up the creek, but almost no sign except for furbearers (mostly marten); also, little moose sign except old tracks on lowlands and lower slopes in the vicinity of Dina Lake.
Tony Creek	M	A few tracks seen along a wet drainage basin at 1200 m on the N-facing side of the valley.
MAP NO. 93 0/6 (24)		
Lower Tony Creek	M	Fresh tracks at 925 m on the W-facing slope coming out of the mountains, and at several locations along the peninsula west of the mouth out to and including the cutblock on Heather Point.

END OF DAY.

16 FEBRUARY 1989: CLEAR AND COLD.

MAP NO. 93 0/6 (29)		
Mackenzie area	M	Working north from town; two bulls (154:2M) seen at the edge of the slough east of the pulp mill.
MAP NO. 93 0/6 (28)		
Reservoir	M	Numerous tracks along the peninsula north of the mills, and one bull (155:1M) seen in thick pine in that area.
MAP NO. 93 0/6 (24)		
Lower Mugaha Creek	M	West of the creek mouth, one bull (156:1M) bedded down in a pine stand on the bench above the reservoir, then two (157:2U) glimpsed in thick timber just to the east.
S. of Tutu Bay	M	One cow (158:1F) in open pine above the reservoir; good deciduous habitat near the lake S of the bay, and some tracks seen; two singles (159:1M, 160:1F) seen along the creek draining into the southeast corner of the bay.

Location	Species	Remarks
Tutu Creek	M	One adult ducked into thick spruce along the lower creek (161:1A); farther upstream, a cow and calf (162:1F,1J) seen in thick timber at 850 m--their's were the only tracks in the area.
MAP NO. 93 0/6 (25)		
Mugaha Creek	M	Two adults (163:1F,1M) seen on a cottonwood bench on the S-facing slope (800 m); tracks common from there on around the corner into Mugaha Creek; tracks to 1225 m on the open forested S-facing slope along the lower valley--one bull (164:1M) seen at about 800 m and a lone cow (165:1F) at 1200 m; fresh tracks frequent in the creek bottom and along the lower south slope for at least 10 km up
	W	the valley; two black wolves, both apparently inexperienced pups and one looking thin and scruffy, seen bedded on a bend of the creek.
Lower Mugaha Crk	M	One adult moose (166:1A) seen briefly in thick spruce along the creek; snow depth in the general area was 45,43,48 = 45.3 cm; fresh tracks common farther down the creek (Map 24), but the animals are apparently staying in the timber.
Morfee Creek	M	Fresh tracks to 1025 m up the north fork, and some older tracks on the shrub meadows along the mainstem below Morfee Lakes; skidoo tracks are common throughout this area.
MAPS NO. 93 0/6 (25,29)		
Gantahaz Lake	M	Nice deciduous uplands to the south show fresh tracks, but no animals could be found.
MAP NO. 93 0/6 (29)		
Morfee Lakes	M	Fresh tracks to 1050 m on the S-facing deciduous slope over the drainage into the northern lake.
Chichouyenily Crk	M	Fresh tracks at 950 m on a S-facing bench over the creek's entrance into the mountains, and on lowlands to the south, but no animals seen.
END OF MORNING FLIGHT (16TH)		
MAPS NO. 93 0/6 (29)		
Gagnon Creek	M	First fresh tracks seen near the mouth of the creek; the creek bottom at the lower end is flat with good shrub meadows, and many of the adjacent cutblocks have good cover and forage characteristics; three moose seen (167:2M,1F); one (168:1F); one (169:1M--Map 93 0/3 (35); one 170:1M); three (171:2F,1M); two (172:2M); there are moose tracks everywhere through this large, old cutover area; hare sign is also

Location	Species	Remarks
		abundant, and two hares were seen from the air in the vicinity of the last two bulls.
Gagnon Creek	M	Back out on the creek proper, most recent sign is below the bridge, and two single moose were finally seen there (173:1F, 174:1M).
MAP NO. 93 0/3 (35)		
Gataiga Creek area	M	Abundant sign and several moose seen in cutblocks to the south of the lower creek: one adult (175:1F); three adults (176:2F,1M); cow with twins (177:1F,2J); one adult that stayed in thick timber (178:1A); one bull (179:1M).
Mischinsinlika Crk	M	Two cow/calf pairs and a single cow (180:1F,1J, 181:1F,1J, 182:1F) in a cutblock just north of the creek.
Gataiga Crk	M	Two adults (183:1M,1F) in a cutblock south of the creek and a cow and calf (184:1F,1J) in thick timber just to the north.
MAP NO. 93 0/7 (30)		
Gataiga Crk	M	Up the creek--tracks common to the lake, but no more animals seen.
MAP NO. 93 0/2 (36)		
Mischinsinlika Crk	M	Two adults (185:1F,1M still with both antlers--spread of about 95 cm) at the edge of an apparently rehabilitated cutblock well north of the creek; they were in tall conifer regeneration with a local patch of aspen.
MAP NO. 93 0/3 (35)		
Gataiga Crk	M	Extensive wetlands along the lower creek, below the RR--a few tracks, and two cows (186:2F) finally seen in thick cover not far from the edge of the reservoir; some potential for mechanical shrub enhancement here.
Mischinsinlika Crk	M	Two adults (187:2A) seen in thick conifer near the mouth of the creek.
MAP NO. 93 0/2 (36)		
Mischinsinlika Crk	M	Back north of the railway, four (188:3M,1F) in a cutblock beside a northern tributary of the creek, then a cow and calf (189:1F,1J) in thick cover along the creek.
Mischinsinlika Crk	M	Cutblocks along the upper creek are too new for animal use, but one adult (190:1A) glimpsed in a patch of timber along the creek, and a set of fresh tracks observed beside the creek at the "turn back" location, about 6 km above the confluence with Izaac Creek (Map 93 0/7 (30); snow depth in the valley bottom a few km downstream was 59,58,56 = 57.7 cm.

Location	Species	Remarks
Izaac Crk	M	No recent sign in the upper sections of this or Trapper Creek.
Below Trapper Crk	M	No sign in the "rehabilitated" eastern half of a large cutblock here, but a few older tracks in the vegetated portion.
Buth Creek	M	Numerous tracks in a large cutblock south of the headwaters lake, but only one moose seen (191:1M), that at the lower (west) end.
Buth Creek	M	Six moose in a small cutblock south of the creek: cow with twins (192:1F,2J); bull with one spike antler (193:1M); cow and calf (194:1F,1J); in a large block to the west, many tracks in the south half, and two pairs of cows (195:2F, 196:2F) in the north.
N. of Buth Crk	M	Tracks in a large cutblock, but no animals seen.
MAP NO. 93 0/3 (35)		
Lower Buth Crk	M	On an old regeneration site between the railway and power line, a cow and calf (197:1F,1J) and two adults (198:1F,1M).
Williston Reservoir	M	From the mouth of Buth Creek, north around the shore back to Mackenzie.
MAP NO. 93 0/6 (29)		
Reservoir	M	One cow moose (199:1F) in upland forest south of the Gagnon Creek bay.

END OF DAY.

17 FEBRUARY 1989: CLEAR AND COLD.

Wolverine Range	C	Intensive caribou survey in morning (see Appendix 3).
MAP NO. 93 0/5 (26)		
S. of Nation River	M	Beginning afternoon flight in the vicinity of some small un-named lakes near the M.U. boundary.
	M	First cutblock in this area: vegetation looks suitable for moose, but apparently it is too high (900-1000 m) at this exposure--no moose and/or tracks.
	M	Lower block to SW, many old tracks and some fresh ones along the lower corner.
	M	Two bull moose (200:2M) seen near one of the lakes to the southwest.
Nation River area	M	Many tracks and beds in cutblocks just above the road.

Location	Species	Remarks
MAP NO. 93 0/5 (22)		
Nation River	M	Tracks continued common in low cutblocks, but only one moose seen, an adult (201:1A) bedded down about 50 m back into the timber off the edge of one block.
Uplands S. of river	M	Rolling terrain with open, rocky knolls and mixed forest including abundant deciduous patches (both aspen and birch) with shrub understory; tracks common throughout, but visibility in conifer patches is poor.
Lower Nation R.	M	In cutblocks to the south, no tracks at or above 900 m; snow depth in a block at that elevation: 67,67,70 = 68 cm.
MAP NO. 93 0/6 (23)		
Upper Dastaiga Area	M	Around lowland meadows and lakes to the NW, there is good shrub growth in some patches, but snow depth may be excessive; little moose sign, mostly old; one cow and calf (202:1F,1J) glimpsed in thick pine on the SW-facing side of a wooded knoll.
Nation River area	0	Good willow meadows near the large, un-named lake south of the mouth (Map 93 0/3 (22), but only hare and lynx tracks (no moose); these swamps are fairly high, at about 925 m.
Dastaiga headwaters	M	Tracks rare in the lowlands, but abundant on two prominent knolls in the area--one bull (203:1M) seen in mixed forest on the eastern one.
Upper Dastaiga	M	There are tracks in most of the older cutblocks in this area; three moose (204:2F,1M), seen in one, then none in a new (or "rehab") block between, then six (205:1M, 206:3F,1J, 207:1F) in another old, well-vegetated adjacent block; most other blocks in the road area are new.
Williston	M	A few tracks in older cutblocks and in upland forest along the edge of the reservoir south of Nation Arm, but no animals seen.
Dastaiga Crk	M	Lots of nice looking valley bottom habitat along the main branch of the creek, but apparently mostly too high or snow too deep; only furbearer sign seen.
MAP NO. 93 0/6 (27)		
Tsedeitla Lake	M	Cutblocks in this area are too new for use by moose

END OF DAY (17TH).

NO FLIGHTS ON 18 FEBRUARY.

Location	Species	Remarks
19 FEBRUARY 1989: CLEAR AND COLD		
MAP NO. 93 0/6 (29)		
Mackenzie area	M	Along the power line, south from town; two moose (208:2F) seen in pine forest along the shared hydro/BCR corridor.
MAP NO. 93 0/3 (35)		
S. of Mackenzie	M	Farther south, near the power line/ highway intersection, there is some sapling aspen and willow, and more tracks than farther north; four adults (209:3M,1F) seen in adjacent pine in that area.
MAP NO. 93 0/3 (36)		
Parsnip River	M	Nice looking habitat and many tracks on an oxbow along the river (partly on Map 93 0/3 (35), but no animals seen.
MAP NO. 93 0/2 (40)		
Misinchinka River	M	Lower 10-15 km with lots of good oxbow shrub meadows; shrubs are high, and could be enhanced; many tracks there, and on aspen slopes to the west.
Bruce Lake area	M	Cutblocks to the east include one with abundant tracks and a long, narrow, apparently thinned one with tracks only along the edge.
MAP NO. 93 0/3 (39)		
Tudya Lake area	M	Small lakes to the north are surrounded by nice aspen ridges; one cow and calf (210:1F,1J) seen, and tracks abundant; one adult seen on the north shore of the main lake, but it would not leave a small patch of spruce and could not be classified (211:1A).
Pack River	M	Excellent shrub meadows on oxbows above the lake, but no animals seen despite an abundance of tracks; good rehabilitation potential.
Lower Pack River	M	All lowland areas have been flooded and there is no significant riparian habitat remaining; a large cutblock to the north is too new for much moose use, but there are a few extrusions of cover, with tracks nearby.
MAP NO. 93 0/3 (35)		
Lower Pack River	M	Uplands to the west of the mouth are old strip-logging blocks--excellent cover and forage, and heavily tracked, although animals are staying out of sight (none seen).
MAP NO. 93 0/3 (34)		
Grayling Lake area	M	Good deciduous cover, but apparently too high upslope and/or wrong exposure--no sign.
Lignite Creek	M	Cow and calf (212:1F,1J) seen in thick pine on the NW-facing slope at 775 m; there are a few

Location	Species	Remarks
		tracks along the creek, but they are mostly old; snow depth: 67,70,64 = 67 cm.
Lignite Creek	W	One wolf track along the creek, but no significant moose sign upstream from the beaver pond where the snow measurement was taken, or on adjacent deciduous slopes.
MAP NO. 93 0/3 (38)		
Robinson Creek	M	Moose kill site found on a logging spur road--only hair and stomach contents remain; wolf scats present, but the only fresh track is that of a single coyote.
	M	Most logging blocks here are too new and/or too high for winter moose use; the only tracks along the upper creek are river otter.
	O	
MAP NO. 93 0/4 (37)		
Philip Creek	M	The upper section in the vicinity of the mouth of Robinson Crk is excellent looking moose habitat--open spruce and pine with many meanders and willow bottomlands; abundant tracks of both moose and furbearers (lynx and marten); one moose seen (213:1M); the snow depth in a willow meadow just up from the creek at 900 m is 60,60,63 = 61 cm.
	O	
	WV	Farther upstream, wolverine tracks and continued abundant moose sign; two cows (214:2F) seen, one of those believed to be a yearling.
	M	
	M	Between some small un-named lakes and the first road crossing--good mixed-forest uplands and a few willow meadows along the creek, but fewer moose tracks; the character of the valley changes above the road to mostly conifer edge and a higher creek gradient with few meanders--and very few tracks.
MAP NO. 93 0/4 (32)		
Witter Lake area	M	More tracks and excellent shrub and upland aspen cover; one bull (215:1M) seen; uplands to the west have ridges and eskers in pine/aspen, and all are heavily tracked.
Above Witter Lake	M	The valley bottom again less attractive for moose--mostly conifer with no shrub meadows and few tracks; good open pine/aspen slopes facing SW, and tracks seen to at least 1075 m along the two main branches of Wheel Creek and the drainage to the north; beaver ponds also present at that level.
MAP NO. 93 0/5 (31)		
Lower Philip Crk	M	Creek bottom with mostly conifer edge and/or new cutblocks, and little moose sign.

Location	Species	Remarks
MAP NO. 93 O/5 (26)		
Upper Nation R.	M	Few tracks in the valley, but fresh ones found at 1175 m on the SW face of a prominent knoll NE of the mouth of Philip Creek.
MAP NO. 93 O/6 (22)		
Nation R. Valley Area	M	Back high (950 m) along the N-facing slope; tracks are common on pine/aspen ridges below that level on this exposure, but there are none above.
MAP NO. 93 O/6 (23)		
Dastaiga headwaters Area	M	Upslope to the west, some local deciduous patches and pine/aspen mix, but only old tracks at 925 m and above.
	M	Snow depth at the edge of a willow meadow at 800 m: 90,90,92 = 90.7 cm; recent tracks to 900 m on an exposed pine ridge, but the animals had moved down to a small lake and were seen (216:1M,1A) in thick spruce there.
MAP NO. 93 O/6 (24)		
S. of Dastaiga Crk	M	More tracks to 925 m in timber to the south; cutblocks in that area are mostly new or denuded by silviculture, and have no cover and forage; some tracks at the edge of the timber near one of those.
	M	Toward the reservoir, good mix of conifer and deciduous cover in an old burn or logging block, and tracks abundant; snow depth in a willow meadow at reservoir level (about 700 m) in that area was 62,64,66 = 66 cm; one cow (217:1F) seen in thick, riparian willow.
MAP NO. 93 O/6 (28)		
Reservoir	M	South of the above, three moose (218:2F,1J) seen at the edge of a newer cutblock just above the reservoir.
LUNCH AND FUEL BREAK (19TH)		
MAP NO. 93 N/16 (9)		
Shoal Lake area		Ground examination of shrub meadows NE of the lake (separate notes, see text); snow depth averaged about 50 cm in openings at about 700 m elevation.
MAP NO. 93 O/12 (14)		
Manson River area	M	Covering cutblocks missed previously; the long, narrow block between the road and river here has a few tracks along the edge, but it is generally too new; south of the road, several older blocks with good cover and forage--many tracks, and several moose seen, as follows: two (219:2M); eleven in the corner of one block (220:4M,6F,1J); at the edge of the timber in a somewhat higher block a cow and calf (221:1F,1J); lower block with excellent

Location	Species	Remarks
		cover, one cow and calf (222:1F,1J), then two bulls (223:2M, one of those with an antler spread of about 30 cm; no fresh sign above about 900 m in this area, although some of the higher blocks appear to have suitable cover.
	M	Many blocks north of the road have been thinned and spaced, and now show little cover and forage and not much evidence of use; tracks are primarily along edges and in the timber.
	M	Back south, one cow (224:1F) in a block west of the mainline road, then three more (225:3F) in an apparently thinnned cutblock with extensive ridges and knolls.
MAP NO. 93 O/6 (24)		
Dastaiga South	M	Along the mainline, there are a few new cutblocks.
MAP NO. 93 O/6 (28)		
Reservoir Area	M	Cutblocks across from Mackenzie; fresh tracks seen in several areas, and four adults (226:2M,2F) finally seen--one bull had one 3-point antler; the upslope limit of tracks in this area is about 875 m; snow depth at 800 m: 65,67,69 = 67 cm; a cow and calf (227:1F,1J) seen in thick timber just above the reservoir.

END OF DAY (19TH).

20 FEBRUARY 1989: CLEAR AND WARMER.

MAP NO. 93 O/6 (28)		
Tsedeka Creek	M	Starting near ferry crossing; a residence at the lower creek belongs to the local trappers (Jacksons); there are numerous sections of open water along this creek; a few tracks to 800 m in old cutblocks along the lower creek, but most fresh tracks are below that level; the area is characterized by good cover, with open conifer of several ages/sizes and with deciduous growth in the openings.
Tsedeka Creek	M	Farther upstream, the first moose seen were a cow and calf (228:1F,1J) on a steep, timbered slope along the east side of the creek; the valley bottom here is narrow, but flat with a good mix of cover and riparian shrub, and tracks are common; three adults (229:1F,2A) seen in thick pine on a ridge at 800 m.
	M	Creek bottom getting narrower, with more conifer, but tracks still present, especially on pine/aspen benches to the west.
	O	Several pines denuded by porcupines.

Location	Species	Remarks
	M	Two adults (230:1M,1A) in open, but mature (tall) pine along the creek mainstem, near the junction, then two more (231:2A) that were bedded in the creek bottom, but moved up into adjacent thick conifer.
S. Fork Tsedeka Crk	M	Several good S-facing pine/aspen slopes, and there are some shrub meadows along the creek meanders; fresh moose tracks to 975 m on the
	O	open-forested slopes; marten tracks seen at several locations.
N. Fork Tsedeka Crk	WV	Wolverine tracks along the creek for several km; it dug into a beaver house and managed to get into the nest chamber, but it was not evident that it succeeded in catching a beaver there; snow depth: 90,90,92 = 90.7 cm; no moose tracks above the fork.

BACK TO BASE TO ASSESS POSSIBLE HELICOPTER MECHANICAL PROBLEM.

MAP NO. 93 0/6 (28)		
N. of Tsedeka Crk	M	Resuming survey (20th, B); abundant tracks in cutblocks along the reservoir north of the creek mouth, but no animals seen.
Modeste L. drainage	M	Up the creek south of Tsedeka: good pine/aspen ridges; tracks common to about 925 m, and one cow moose (232:1F) seen at 775 m.
MAP NO. 93 0/3 (34)		
Scovil Creek	M	Cutblocks adjacent to the lower section include some that have been thinned and now show little moose use; others are older, with good deciduous growth, and are heavily tracked; a nice willow meadow in the creek bottom just above the road crossing has only old tracks.
	M	Farther upstream, open aspen ridges with blocks of pine--there are tracks to about 925 m, and two moose seen, a bull (233:1M) at 900 m with with snow about two-thirds up its legs, and another bull (234:1M) at 875 m on a steeper slope with shallower snow.
S. of Scovil Crk	M	Extensive cut areas: some blocks are too high upslope, too new, or recently thinned, and are not currently being used; crossed one nice looking block at 950 m, but saw only old tracks there and on adjacent blocks at that or somewhat lower levels; most fresh tracks in lower blocks are at the edges--no moose seen in blocks above the road, although there were certainly some present in adjacent

Location	Species	Remarks
		timber; snow depth beside a small lake at 800 m was 70,72,75 = 72.3 cm.
S. of Scovil Crk	M	Old cutblocks east of the road--excellent mix of conifer and deciduous growth, and abundant
	O	sign of moose, hares, and furbearers; several moose seen: one cow (235:1F) and another only glimpsed in thick timber nearby (236:1U) may have been her calf, but neither could be found again; also two adults (237:1M,1F) in a nearby cutblock.
	O	On a long, low ridge in one of the cutblocks, the ground is completely tracked up by hares and 10+ were actually seen from the air in a single pass along it; some of these blocks have been partially thinned, but moose and hare sign is in unthinned segments; more moose seen: one cow (238:1F), then a bull and cow (239:1M,1F), and a large, cantankerous bull (240:1M) that threatened the helicopter; hare and moose tracks continued abundant in blocks just above the reservoir; the last moose seen are a cow and calf (241:1F,1J) at the edge of thick timber near a creek mouth.

* * END OF SURVEYS * *

APPENDIX 2. SUMMARY OF MOOSE OBSERVATION DATA FROM SURVEYS IN THE SOUTHERN WILLISTON RESERVOIR AREA, BRITISH COLUMBIA, 1989 (a condensation from detailed notes in Appendix 1).

OBS. NO.	DATE (FEB.)	MAP M.U.	MAP SHEET	MAP[1]	HAB[2]	ELEV. (m)	NUMBER OF MOOSE M	F	J	A	U	TOTAL	BULLS WITH ANTLERS	SETS OF TWINS
1	11th	38	93 N/15	-	RS	800	-	1	1	-	-	2		
2	11th	38	93 N/15	-	RS	800	5	-	-	-	-	5		
3	11th	38	93 N/15	-	RT	800	-	1	1	-	-	2		
4	11th	38	93 N/15	-	RS	800	3	-	-	-	-	3		
5	11th	38	94 C/2	1	UD	1050	-	-	-	-	2	2		
6	11th	29	94 C/1	2	UD	875	-	1	1	-	-	2		
7	11th	29	94 C/1	2	SU	1225	1	2	-	-	-	3		
8	11th	29	94 C/1	2	SU	1375	1	1	-	-	-	2		
9	11th	29	94 C/1	4	SU	1375	-	1	1	-	-	2		
10	11th	29	94 C/1	3	CB	700	-	1	2	-	-	3		1
11	11th	29	93 N/16	5	BU	725	-	1	2	-	-	3		1
12	11th	29	93 N/16	5	BU	725	-	1	-	-	-	1		
13	11th	29	93 N/16	5	CB	800	2	-	-	-	-	2		
14	11th	29	93 N/16	5	CT	850	-	1	1	-	-	2		
15	11th	29	93 N/16	5	CB	775	-	1	2	-	-	3		1
16	11th	29	93 N/16	5	CB	775	1	1	-	-	-	2		
17	11th	29	93 N/16	5	CB	700	2	-	-	-	-	2		
18	11th	29	93 N/16	6	UD	700	1	1	-	-	-	2		
19	11th	29	93 N/16	6	UD	700	1	-	-	-	-	1		
20	11th	29	93 N/16	6	MU	700	-	1	-	-	-	1		
21	11th	29	93 0/13	7	RS	700	2	1	-	-	-	3	2	
22	11th	29	93 0/13	10	RS	700	1	-	-	-	-	1		
23	11th	29	93 0/12	15	CB	725	-	1	1	-	-	2		
24	11th	29	93 0/12	15	CB	725	-	1	1	-	-	2		
25	11th	29	93 0/12	15	CB	725	-	1	1	-	-	2		
26	12th	29	93 0/12	18	RS	725	-	1	1	-	-	2		
27	12th	29	93 0/12	18	CT	725	-	1	1	-	-	2		
28	12th	29	93 0/12	18	CB	725	-	1	-	-	-	1		
29	12th	29	93 0/12	18	CT	725	-	1	1	-	-	2		
30	12th	29	93 0/12	18	MU	725	-	2	-	-	-	2		
31	12th	29	93 0/12	15	RT	725	-	1	1	-	-	2		
32	12th	29	93 0/12	15	RT	700	-	1	1	-	-	2		
33	12th	29	93 0/12	14	RT	700	-	2	-	-	-	2		
34	12th	29	93 0/12	14	RT	700	-	1	1	-	-	2		
35	12th	29	93 0/12	13	CB	1225	1	-	-	-	-	1		
36	12th	29	93 0/12	13	CB	900	-	1	-	-	-	1		
37	12th	29	93 0/12	13	CB	875	-	1	1	-	-	2		
38	12th	29	93 0/12	14	CB	975	-	1	2	-	-	3		1
39	12th	29	93 0/12	14	CB	875	2	2	-	-	-	4	1	
40	12th	29	93 0/12	14	CB	900	1	2	-	-	-	3		
41	12th	29	93 0/12	14	CB	900	1	1	-	-	-	2		
42	12th	29	93 0/12	14	CB	875	-	1	1	-	-	2		
43	12th	29	93 0/13	10	CB	875	1	-	-	-	-	1		
44	12th	29	93 0/13	10	CB	875	1	1	-	-	-	2		
45	12th	29	93 0/13	10	CB	850	1	-	-	-	-	1		
46	12th	29	93 0/12	14	CB	875	-	1	1	-	-	2		
47	12th	29	93 0/12	14	CB	825	-	1	-	-	-	1		

Appendix 2 (continued)

OBS. NO.	DATE (FEB.)	MAP M.U.	MAP SHEET	MAP	HAB.	ELEV.	NUMBER OF MOOSE M	F	J	A	U	TOTAL	BULLS WITH ANTLERS	SETS OF TWINS
48	12th	29	93 0/12	14	CT	750	1	1	1	-	-	3		
49	12th	29	93 0/13	10	MU	725	-	3	_	_	_	3		
50	12th	29	93 N/16	9	MU	750	-	1	1	-	-	2		
51	12th	29	93 N/16	9	CB	750	2	1	_	_	_	3		
52	12th	29	93 N/16	9	CB	750	-	1	1	-	-	2		
53	12th	29	93 N/16	9	CB	750	4	-	_	_	_	4		
54	12th	29	93 N/16	9	CB	725	1	3	-	-	-	4		
55	12th	29	93 N/16	6	CB	750	-	1				2		
56	12th	29	93 N/16	6	CB	750	-	2	1	-	-	2		
57	12th	29	93 N/16	6	CB	750	1	-	-	-	-	1		
58	12th	29	93 N/16	6	CB	750	-	1	1	-	-	2		
59	12th	29	93 N/16	6	CB	750	1	-	_	_	_	1		
60	12th	29	93 N/16	5	CB	750	-	1	1	-	-	2		
61	12th	29	93 N/16	5	CB	750	1	1	-	-	-	2		
62	12th	29	93 N/16	6	CB	750	-	1	1	-	-	2		
63	12th	29	93 N/16	6	CB	750	2	3	_	_	_	5	2	
64	12th	29	93 N/16	6	CB	750	-	3	-	-	-	3		
65	12th	29	93 N/16	6	CB	750	-	2	-	-	-	2		
66	12th	29	93 N/16	6	CB	750	-	2	-	-	-	2		
67	12th	29	93 N/16	6	CB	750	-	1	1	-	-	2		
68	12th	30	93 0/13	8	UD	975	2	3	_	_	_	5		
69	13th	29	93 0/12	19	CB	775	-	1	1	-	-	2		
70	13th	29	93 0/12	19	CB	775	1	-	_	_	_	1		
71	13th	29	93 0/5	22	CB	775	1	1	_	_	_	2	1	
72	13th	29	93 0/5	22	CB	775	1	-	_	_	_	1	1	
73	13th	29	93 0/5	22	CT	775	-	1	1	-	-	2		
74	13th	29	93 0/5	22	CT	775	-	1	-	-	-	1		
75	13th	29	93 0/11	20	CB	900	-	1	-	-	-	1		
76	13th	29	93 0/12	19	CB	925	3	-	-	-	-	3		
77	13th	29	93 0/12	19	CB	925	-	2	-	-	-	2		
78	13th	29	93 0/12	19	CB	925	-	1	1	-	-	2		
79	13th	29	93 0/12	19	MU	875	-	1	_	_	_	1		
80	13th	29	93 0/12	19	CB	925	_	1	1	-	-	2		
81	13th	29	93 0/12	19	CB	825	1	1	_	_	_	2		
82	13th	29	93 0/12	19	CB	825	4	5	_	_	_	9	3	
83	13th	29	93 0/12	19	CB	800	1	-	-	-	-	1	1	
84	13th	29	93 0/12	19	CB	800	1	-	-	-	-	1		
85	13th	29	93 0/12	19	CB	825	-	1	_	_	_	1		
86	13th	29	93 0/12	19	CB	825	-	1	1	-	-	2		
87	13th	29	93 0/12	19	RS	750	-	1	-	-	-	1		
88	13th	29	93 0/12	19	RS	750	1	-	_	_	_	1		
89	13th	29	93 0/12	19	UC	825	-	1	1	-	-	2		
90	13th	29	93 0/12	19	RS	750	1	-	-	-	-	1		
91	13th	29	93 0/12	19	CT	850	2	-	_	_	_	2		
92	13th	29	93 0/12	19	UC	800	-	1	1	-	-	2		
93	13th	29	93 0/12	18	CT	775	-	1	1	-	-	2		
94	13th	29	93 0/12	18	CB	825	1	2	_	_	_	3	1	
95	13th	29	93 0/12	18	CB	775	-	1	1	-	-	2		
96	13th	29	93 0/12	18	CB	775	1	2	-	-	-	3		
97	13th	29	93 0/12	18	CB	900	1	3	_	_		4		
98	13th	29	93 0/12	18	CB	1000	1	-	_	_	_	1		

Appendix 2 (continued)

OBS. NO.	DATE (FEB.)	M.U.	MAP SHEET	MAP	HAB.	ELEV.	NUMBER OF MOOSE M	F	J	A	U	TOTAL	BULLS WITH ANTLERS	SETS OF TWINS
99	13th	29	93 0/12	18	CB	1000	-	1	-	-	-	1		
100	13th	29	93 0/12	18	CB	750	-	1	-	-	-	1		
101	13th	29	93 0/12	18	MU	750	2	-	-	-	-	2		
102	14th	29	93 0/6	23	UC	800	-	-	-	1	-	1		
103	14th	29	93 0/5	22	UD	750	-	1	-	-	-	1		
104	14th	29	93 0/5	26	UD	875	-	2	-	-	-	2		
105	14th	29	93 0/5	26	UD	800	-	1	1	-	-	2		
106	14th	29	93 0/5	22	UD	800	1	-	-	-	-	1		
107	14th	29	93 0/5	22	UD	950	-	2	-	-	-	2		
108	14th	29	93 0/5	22	UD	700	-	1	-	-	-	1		
109	14th	29	93 0/5	22	UD	750	1	1	-	-	-	2		
110	14th	29	93 0/5	22	UD	800	-	1	-	-	-	1		
111	14th	29	93 0/5	22	CB	750	1	-	-	-	-	1	1	
112	14th	29	93 0/11	20	CB	775	-	1	1	-	-	2		
113	14th	29	93 0/11	20	CB	775	1	2	-	-	-	3		
114	14th	29	93 0/11	20	CB	775	-	2	-	-	-	2		
115	14th	29	93 0/11	20	CB	775	1	2	-	-	-	3		
116	14th	29	93 0/5	22	CB	800	2	-	-	-	-	2		
117	14th	29	93 0/5	22	CB	800	1	-	-	-	-	1		
118	14th	29	93 0/12	19	MU	750	2	1	-	-	-	3		
119	14th	29	93 0/5	22	CB	750	-	1	-	-	-	1		
120	14th	29	93 0/5	22	CT	775	1	-	-	-	-	1		
121	14th	29	93 0/12	19	RS	750	-	3	-	-	-	3		
122	14th	30	93 0/13	11	CB	1000	-	2	-	-	-	2		
123	14th	30	93 0/13	11	CB	900	-	1	-	-	-	1		
124	14th	30	93 0/13	11	CB	750	1	2	-	-	-	3		
125	14th	30	93 0/13	11	CB	750	-	2	-	-	-	2		
126	14th	30	93 0/13	11	CB	725	1	-	-	-	-	1		
127	14th	30	93 0/13	11	CB	750	1	2	-	-	-	3	1	
128	14th	30	93 0/13	11	CB	750	1	-	-	-	-	1		
129	14th	30	93 0/13	11	CB	725	-	1	1	-	-	2		
130	14th	30	93 0/13	11	CB	750	-	1	-	-	-	1		
131	14th	30	93 0/13	12	CT	725	1	-	-	-	-	1		
132	14th	30	93 0/13	11	UC	725	-	-	-	-	2	2		
133	14th	30	93 0/13	12	CB	800	-	3	-	-	-	3		
134	14th	30	93 0/13	12	UC	775	-	1	1	-	-	2		
135	14th	30	93 0/13	12	CB	725	-	1	-	-	-	1		
136	14th	30	93 0/13	11	CB	725	-	1	-	-	-	1		
137	14th	30	93 0/12	16	UC	700	1	-	-	-	-	1		
138	15th	29	93 N/16	5	CB	750	1	-	-	-	-	1		
139	15th	29	93 N/16	5	CB	750	-	1	-	-	-	1		
140	15th	29	93 N/16	5	CB	775	-	2	-	-	-	2		
141	15th	29	93 N/16	5	CB	775	1	-	-	-	-	1		
142	15th	29	93 0/12	19	RT	725	-	2	-	-	-	2		
143	15th	29	93 0/12	18	RT	725	1	-	-	-	-	1		
144	15th	29	93 0/12	18	CB	800	-	2	-	-	-	2		
145	15th	29	93 0/12	18	CB	800	2	-	-	-	-	2		
146	15th	30	93 0/11	17	SU	1225	-	1	1	-	-	2		
147	15th	30	93 0/11	17	UD	925	-	1	-	-	-	1		
148	15th	30	93 0/11	20	CB	725	-	1	2	-	-	3		1
149	15th	30	93 0/11	20	RS	775	-	1	-	-	-	1		

Appendix 2 (continued)

OBS. NO.	DATE (FEB.)	MAP M.U.	MAP SHEET	MAP	HAB.	ELEV.	NUMBER OF MOOSE M	F	J	A	U	TOTAL	BULLS WITH ANTLERS	SETS OF TWINS
150	15th	30	93 0/11	20	CT	800	-	-	-	1	-	1		
151	15th	30	93 0/11	20	CB	750	1	1	-	-	-	2		
152	15th	30	93 0/11	20	UC	725	-	1	1	-	-	2		
153	15th	30	93 0/11	20	CB	750	1	1	-	-	-	2		
154	16th	30	93 0/6	29	RT	725	2	-	-	-	-	2		
155	16th	30	93 0/6	28	UC	750	1	-	-	-	-	1		
156	16th	30	93 0/6	24	UC	725	1	-	-	-	-	1		
157	16th	30	93 0/6	24	UC	725	-	-	-	-	2	2		
158	16th	30	93 0/6	24	UC	725	-	1	-	-	-	1		
159	16th	30	93 0/6	24	UD	725	-	1	-	-	-	1		
160	16th	30	93 0/6	24	UD	725	1	-	-	-	-	1		
161	16th	30	93 0/6	24	UC	725	-	-	-	1	-	1		
162	16th	30	93 0/6	24	UC	850	-	1	1	-	-	2		
163	16th	30	93 0/6	25	UD	800	1	1	-	-	-	2		
164	16th	30	93 0/6	25	UD	800	1	-	-	-	-	1		
165	16th	30	93 0/6	25	UD	1200	-	1	-	-	-	1		
166	16th	30	93 0/6	25	UC	725	-	-	-	1	-	1		
167	16th	30	93 0/6	29	CB	750	2	1	-	-	-	3		
168	16th	30	93 0/6	29	CB	750	-	1	-	-	-	1		
169	16th	30	93 0/3	35	CB	750	1	-	-	-	-	1		
170	16th	30	93 0/6	29	CB	750	1	-	-	-	-	1		
171	16th	30	93 0/6	29	CB	750	1	2	-	-	-	3		
172	16th	30	93 0/6	29	CB	775	2	-	-	-	-	2		
173	16th	30	93 0/6	29	CB	725	-	1	-	-	-	1		
174	16th	30	93 0/6	29	CB	725	1	-	-	-	-	1		
175	16th	30	93 0/3	35	CB	750	-	1	-	-	-	1		
176	16th	30	93 0/3	35	CB	775	1	2	-	-	-	3		
177	16th	30	93 0/3	35	CT	750	-	1	2	-	-	3		1
178	16th	30	93 0/3	35	CT	750	* -	-	-	1	-	1		
179	16th	30	93 0/3	35	CB	750	1	-	-	-	-	1		
180	16th	30	93 0/3	35	CB	750	-	1	1	-	-	2		
181	16th	30	93 0/3	35	CB	750	-	1	1	-	-	2		
182	16th	30	93 0/3	35	CB	750	-	1	-	-	-	1		
183	16th	30	93 0/3	35	CB	775	1	1	-	-	-	2		
184	16th	30	93 0/3	35	UC	750	-	1	1	-	-	2		
185	16th	30	93 0/2	36	CB	800	1	1	-	-	-	2	1	
186	16th	30	93 0/3	35	MU	700	-	2	-	-	-	2		
187	16th	30	93 0/3	35	UC	725	-	-	-	2	-	2		
188	16th	30	93 0/2	36	CB	775	3	1	-	-	-	4		
189	16th	30	93 0/2	36	RT	750	-	1	1	-	-	2		
190	16th	30	93 0/2	36	UC	750	-	-	-	1	-	1		
191	16th	30	93 0/2	36	CB	825	1	-	-	-	-	1		
192	16th	30	93 0/2	36	CB	875	-	1	2	-	-	3		1
193	16th	30	93 0/2	36	CB	875	1	-	-	-	-	1	1	
194	16th	30	93 0/2	36	CB	875	-	1	1	-	-	2		
195	16th	30	93 0/2	36	CB	800	-	2	-	-	-	2		
196	16th	30	93 0/2	36	CB	800	-	2	-	-	-	2		
197	16th	30	93 0/3	35	CB	750	-	1	1	-	-	2		
198	16th	30	93 0/3	35	CB	750	1	1	-	-	-	2		
199	16th	30	93 0/6	29	UC	725	-	1	-	-	-	1		
200	17th	29	93 0/5	26	RT	800	2	-	-	-	-	2		

Appendix 2 (continued)

OBS. NO.	DATE (FEB.)	M.U.	MAP SHEET	MAP	HAB.	ELEV.	NUMBER OF MOOSE M	F	J	A	U	TOTAL,	BULLS WITH ANTLERS	SETS OF TWINS
201	17th	29	93 0/5	22	CT	800	-	-	-	1	-	1		
202	17th	29	93 0/6	23	UC	875	-	1	1	-	-	2		
203	17th	29	93 0/6	23	UD	950	1	-	-	-	-	1		
204	17th	29	93 0/6	23	CB	775	1	2	-	-	-	3		
205	17th	29	93 0/6	23	CB	800	1	-	-	-	-	1		
206	17th	29	93 0/6	23	CB	800	-	3	1	-	-	4		
207	17th	29	93 0/6	23	CB	800	-	1	-	-	-	1		
208	19th	30	93 0/6	29	UC	725	-	2	-	-	-	2		
209	19th	30	93 0/3	35	UC	750	3	1	-	-	-	4		
210	19th	24	93 0/3	39	UD	725	-	1	1	-	-	2		
211	19th	24	93 0/3	39	RT	700	-	-	-	1	-	1		
212	19th	29	93 0/3	34	UC	775	-	1	1	-	-	2		
213	19th	28	93 0/3	37	RS	850	1	-	-	-	-	1		
214	19th	29	93 0/3	37	RS	850	-	2	-	-	-	2		
215	19th	29	93 0/4	32	UD	850	1	-	-	-	-	1		
216	19th	29	93 0/6	23	RT	875	1	-	-	1	-	2		
217	19th	29	93 0/6	24	RS	700	-	1	-	-	-	1		
218	19th	29	93 0/6	28	CB	700	-	2	1	-	-	3		
219	19th	29	93 0/12	14	CB	800	2	-	-	-	-	2		
220	19th	29	93 0/12	14	CB	800	4	6	1	-	-	11		
221	19th	29	93 0/12	14	CT	875	-	1	1	-	-	2		
222	19th	29	93 0/12	14	CB	850	-	1	1	-	-	2		
223	19th	29	93 0/12	14	CB	825	2	-	-	-	-	2	1	
224	19th	29	93 0/12	14	CB	875	-	1	-	-	-	1		
225	19th	29	93 0/12	14	CB	775	-	3	-	-	-	3		
226	19th	29	93 0/6	28	CB	725	2	2	-	-	-	4	1	
227	19th	29	93 0/6	28	UC	700	-	1	1	-	-	2		
228	20th	29	93 0/6	28	UC	750	-	1	1	-	-	2		
229	20th	29	93 0/6	28	UC	800	-	1	-	2	-	3		
230	20th	29	93 0/6	28	UC	775	1	-	-	1	-	2		
231	20th	29	93 0/6	28	RT	775	-	-	-	2	-	2		
232	20th	29	93 0/6	28	UD	775	-	1	-	-	-	1		
233	20th	29	93 0/3	34	UD	900	1	-	-	-	-	1		
234	20th	29	93 0/3	34	UD	875	1	-	-	-	-	1		
235	20th	29	93 0/3	34	CB	775	-	1	-	-	-	1		
236	20th	29	93 0/3	34	UC	775	-	-	-	-	1	1		
237	20th	29	93 0/3	34	CB	775	1	1	-	-	-	2		
238	20th	29	93 0/3	34	CT	800	-	1	-	-	-	1		
239	20th	29	93 0/3	34	CB	775	1	1	-	-	-	2		
240	20th	29	93 0/3	34	CB	750	1	-	-	-	-	1		
241	20th	29	93 0/3	34	CT	750	-	1	1	-	-	2		

[1]Individual map number as compiled in Appendix 6.

[2]Habitats: BU = Burn; CB = Forestry cutblock; CT = Timber at the edge of a cutblock; MU = Muskeg, bog; RS = Riparian shrub (mostly willow, alder); RT = Riparian timber (mostly cottonwood); SU = subalpine (mostly balsam); UC = Upland conifer (pine and/or spruce dominant); UD = Upland deciduous (aspen and/or birch dominant).

APPENDIX 3. LOGGING AND SILVICULTURE DATA[1] AS RELATED TO MOOSE OBSERVATIONS IN THE SOUTHERN WILLISTON RESERVOIR AREA, BRITISH COLUMBIA, 1989.

OBS. NO.[2]	DATE (FEB.)	M.U.	MAP SHEET	NO. MOOSE SEEN	CUT AGE (YRS)	FOREST DEVELOPMENT HISTORY[3] EARLY SITE PREP.	LATER SILVICULTURE TREATMENT	SILV. AGE (YRS)
15	11th	29	93 N/16	3	16	NONE	PLANT ONLY	13
16	11th	29	93 N/16	2	16	NONE	PLANT ONLY	13
17	11th	29	93 N/16	2	17	MECH	BRUSH/WEED, JUV. SPACE	2
24	11th	29	93 O/12	2	11	MECH	PLANT ONLY	9
25	11th	29	93 O/12	2	11	MECH	PLANT ONLY	4
39	12th	29	93 O/12	4	12	NONE	NONE	12
40	12th	29	93 O/12	3	12	NONE	NONE	12
41	12th	29	93 O/12	2	11	NONE	NONE	11
42	12th	29	93 O/12	2	11	NONE	NONE	11
46	12th	29	93 O/12	2	13	MECH	BRUSH AND WEED	3
51	12th	29	93 N/16	3	12	NONE	NONE	12
52	12th	29	93 N/16	2	11	BURN	NONE	9
53	12th	29	93 N/16	4	13	NONE	NONE	13
54	12th	29	93 N/16	4	12	NONE	NONE	12
55	12th	29	93 N/16	2	12	BURN	NONE	10
56	12th	29	93 N/16	2	12	BURN	NONE	10
57	12th	29	93 N/16	1	1	NONE	NONE	1
58	12th	29	93 N/16	2	12	NONE	NONE	12
59	12th	29	93 N/16	1	12	NONE	NONE	12
60	12th	29	93 N/16	2	11	NONE	NONE	11
61	12th	29	93 N/16	2	11	NONE	NONE	11
62	12th	29	93 N/16	2	12	NONE	NONE	12
63	12th	29	93 N/16	5	12	NONE	NONE	12
64	12th	29	93 N/16	3	12	NONE	NONE	12
65	12th	29	93 N/16	2	13	NONE	NONE	13
66	12th	29	93 N/16	2	13	NONE	NONE	13
67	12th	29	93 N/16	2	13	MECH	NONE	12
69	13th	29	93 O/12	2	18	NONE	NONE	18
70	13th	29	93 O/12	1	18	NONE	NONE	18
112	14th	29	93 O/11	2	19	NONE	NONE	19
113	14th	29	93 O/11	3	19	NONE	NONE	19
114	14th	29	93 O/11	2	19	NONE	NONE	19
115	14th	29	93 O/11	3	19	NONE	NONE	19
122	14th	30	93 O/13	2	17	BURN	PLANT ONLY	15
123	14th	30	93 O/13	1	16	MECH	PLANT ONLY	11
124	14th	30	93 O/13	3	18	NONE	MECHANICAL SITE PREP.	11
125	14th	30	93 O/13	2	12	MECH	PLANT ONLY	10
126	14th	30	93 O/13	1	12	MECH	PLANT ONLY	10
127	14th	30	93 O/13	3	12	MECH	PLANT ONLY	10
128	14th	30	93 O/13	1	16	MECH	PLANT ONLY	11
129	14th	30	93 O/13	2	14	NONE	MECH. PREP., PLANT	3
130	14th	30	93 O/13	1	14	NONE	MECH. PREP., PLANT	3
133	14th	30	93 O/13	3	7	MECH	NONE	6
135	14th	30	93 O/13	1	16	NONE	NONE	16
136	14th	30	93 O/13	1	16	NONE	NONE	16
138	15th	29	93 N/16	1	15	MECH	NONE	13

Appendix 3 (continued)

OBS. NO.[2]	DATE (FEB.)	M.U.	MAP SHEET	NO. MOOSE SEEN	CUT AGE (YRS)	FOREST DEVELOPMENT HISTORY[3] EARLY SITE PREP.	LATER SILVICULTURE TREATMENT	SILV. AGE (YRS)
139	15th	29	93 N/16	1	15	MECH	NONE	13
140	15th	29	93 N/16	2	15	MECH	NONE	13
141	15th	29	93 N/16	1	15	MECH	NONE	13
219	19th	29	93 0/12	2	12	NONE	NONE	12
220	19th	29	93 0/12	11	13	MECH	NONE	12
222	19th	29	93 0/12	2	14	NONE	NONE	14
223	19th	29	93 0/12	2	14	NONE	NONE	14
224	19th	29	93 0/12	1	14	NONE	NONE	14
301	14th	29	93 0/11	0	19	NONE	BRUSH/WEED, SPRAY, PLANT	4
302	14th	29	93 0/11	0	19	NONE	NONE	19
303	14th	29	93 0/11	0	19	MECH	NONE	18
304	19th	29	93 0/12	0	5	MECH	PLANT ONLY	3
305	19th	29	93 0/12	0	11	BURN	PLANT ONLY	9
306	11th	29	93 0/12	0	6	NONE	PLANT ONLY	3
307	13th	29	93 0/12	0	5	NONE	PLANT ONLY	3
308	13th	29	93 0/12	0	4	MECH	PLANT ONLY	3
309	13th	29	93 0/12	0	9	NONE	NONE	9
310	13th	29	93 0/12	0	18	MECH	JUVENILE SPACE	9
311	13th	29	93 0/12	0	9	NONE	NONE	9
312	13th	29	93 0/12	0	17	NONE	PLANT ONLY	9
313	13th	29	93 0/12	0	9	NONE	PLANT ONLY	6
314	12th	29	93 0/12	0	12	MECH	NONE	11
315	12th	29	93 0/12	0	11	NONE	PLANT ONLY	8
316	12th	29	93 0/12	0	11	NONE	NONE	11
317	19th	29	93 0/12	0	5	MACH	PLANT ONLY	2
318	12th	29	93 0/12	0	11	MECH	NONE	11
319	19th	29	93 0/12	0	3	CHEM	PLANT ONLY	2
320	19th	29	93 0/12	0	5	NONE	PLANT ONLY	4
321	19th	29	93 0/12	0	11	NONE	PLANT ONLY	1
322	19th	29	93 0/12	0	13	MECH	NONE	12
323	19th	29	93 0/12	0	14	MECH	NONE	12
324	12th	29	93 0/12	0	15	MECH	BRUSH/WEED, JUV. SPACE	1
325	19th	29	93 0/12	0	15	MECH	BRUSH/WEED, FERTILIZE	4
326	19th	29	93 0/12	0	6	MECH	HACK/SQUIRT, PLANT	4
327	19th	29	93 0/12	0	15	MECH	BRUSH AND WEED	2
328	19th	29	93 0/12	0	14	MECH	BRUSH/WEED, FERTILIZE	3
329	14th	30	93 0/13	0	4	MECH	NONE	4
330	14th	30	93 0/13	0	4	MACH	NONE	4
331	14th	30	93 0/13	0	4	MECH	NONE	4
332	14th	30	93 0/13	0	17	MECH	PLANT ONLY	15
333	14th	30	93 0/13	0	17	MECH	PLANT ONLY	15
334	14th	30	93 0/13	0	6	BURN	PLANT ONLY	5
335	14th	30	93 0/13	0	7	BURN	PLANT ONLY	5
336	14th	30	93 0/13	0	17	MECH	PLANT ONLY	15
337	14th	30	93 0/13	0	6	BURN	HACK/SQUIRT, PLANT	2
338	14th	30	93 0/13	0	17	BURN	PLANT ONLY	16
339	14th	30	93 0/13	0	6	BURN	HACK/SQUIRT, PLANT	2
340	14th	30	93 0/13	0	18	MECH	PLANT ONLY	17
341	14th	30	93 0/13	0	19	BURN	PLANT ONLY	16
342	14th	30	93 0/13	0	6	BURN	PLANT ONLY	5

Appendix 3 (continued)

OBS. NO.[2]	DATE (FEB.)	M.U.	MAP SHEET	NO. MOOSE SEEN	CUT AGE (YRS)	FOREST DEVELOPMENT HISTORY[3] EARLY SITE PREP.	LATER SILVICULTURE TREATMENT	SILV. AGE (YRS)
343	14th	30	93 O/13	0	17	MECH	PLANT ONLY	15
344	14th	30	93 O/13	0	17	BURN	MECH. PREP., PLANT	12
345	14th	30	93 O/13	0	17	BURN	PLANT ONLY	13
346	14th	30	93 O/13	0	7	BURN	NONE	6
347	14th	30	93 O/13	0	17	MECH	PLANT ONLY	11
348	14th	30	93 O/13	0	15	NONE	MECH. PREP., PLANT	3
349	14th	30	93 O/13	0	8	MECH	PLANT ONLY	6
350	14th	30	93 O/13	0	17	NONE	PLANT ONLY	13
351	14th	30	93 O/13	0	15	BURN	PLANT ONLY	10
352	14th	30	93 O/13	0	14	NONE	MECHANICAL SITE PREP.	4
353	14th	30	93 O/13	0	17	MECH	PLANT ONLY	14
354	14th	30	93 O/13	0	16	MECH	PLANT ONLY	14
355	14th	30	93 O/13	0	7	MECH	NONE	6
356	14th	30	93 O/13	0	14	NONE	MECHANICAL SITE PREP.	10
357	12th	29	93 O/13	0	11	NONE	NONE	11
358	12th	29	93 O/13	0	11	MECH	PLANT ONLY	10
360	11th	29	93 N/16	0	16	BURN	JUVENILE SPACE	1
361	11th	29	93 N/16	0	16	MECH	BRUSH/WEED, JUV. SPACE	2
362	11th	29	93 N/16	0	16	MECH	PLANT ONLY	6
363	11th	29	93 N/16	0	15	BURN	JUVENILE SPACE	1
364	11th	29	93 N/16	0	4	MECH	JUVENILE SPACE	1
365	11th	29	93 N/16	0	15	CHEM	MECHANICAL SITE PREP.	3
366	15th	29	93 N/16	0	15	BURN	NONE	14
367	15th	29	93 N/16	0	15	BURN	NONE	14
368	15th	29	93 N/16	0	3	NONE	PLANT ONLY	2
369	12th	29	93 N/16	0	11	NONE	PLANT ONLY	9
370	12th	29	93 N/16	0	13	MECH	NONE	12
371	12th	29	93 N/16	0	6	NONE	NONE	6
372	12th	29	93 N/16	0	9	MECH	NONE	8
373	12th	29	93 N/16	0	5	CHEM	NONE	5
374	12th	29	93 N/16	0	12	NONE	NONE	12
375	12th	29	93 N/16	0	13	NONE	NONE	13

[1]Logging and silviculture data from Ministry of Forests files, Mackenzie, B.C. This compilation represents a sample of cutblocks observed during aerial surveys, 11-20 February 1989.

[2]Observation numbers 15-224 correspond with those listed as "CB" under the habitat column in Appendix 2; numbers 301-375 represent other cutblocks known to have been covered on the four NTS mapsheets indicated, but in which no moose were seen (see text). The 300 series (no moose) blocks are not specifically identified on the accompanying maps.

[3] Forest development history: "CUT AGE" indicates time, in years, since the block was logged, "EARLY SITE PREP." identifies silvicultural activities within 2 years of logging (including "MACH" = both mechanical and chemical means), and "SILV. AGE" is the time since the last forestry activity in the area (including logging, but not fertilizing).

APPENDIX 4. COMPARISON OF MOOSE HABITAT CAPABILITY AND UTILIZATION ASSESSMENTS, IN THE SOUTHERN WILLISTON RESERVOIR AREAS, BRITISH COLUMBIA, 1975 VERSUS 1989.

Bonar (1975) provided early verbal descriptions, assessments, and predictions for wildlife habitat use in the Williston Reservoir area. Those accounts are quoted or summarized (1975) and updated from my recent experience (1985) below:

MANAGEMENT UNIT 7-29 (NORTH TO SOUTH)

Omineca Arm

1975 - The burn west of Muscovite Lakes is described as "...the most prominent habitat feature..." in the area, providing excellent moose winter range.

1989 - That area, and adjacent or associated cutblocks, were still being well-used by moose in February 1989. Two different sets of twin calves were seen there, within a short distance of each other.

Muscovite Lakes

1975 - Reportedly important to moose in summer, and less so but still important in winter.

1989 - We saw relatively little sign and only three moose along the main chain of lakes, although cutblocks to the west (near the two lakes labelled "Muscovite" on NTS maps) were fairly productive.

Omineca Point

1975 - The area west of the Muscovite lakes, described as mostly pineflats with low wildlife values.

1989 - That assessment still pertains.

Strandberg/Fries Creek Area

1975 - Among the features described is an old burn--then at the peak of its usefulness to moose--but most of the area was considered to have relatively low wildlife values.

1989 - Logging has apparently enhanced moose wintering potential in the area, as some of the highest local densities among our observations were in cutblocks along those two creeks.

Lower Eklund Creek/Shoal Lakes Area

1975 - The extensive swamps and shrub meadows in the area reportedly "...receive high usage by wintering moose".

1989 - Although we found a few moose in adjacent cutblocks, and sign was common throughout the area, the extent of occurrence in February 1989 was less than I would have expected--it still appears to have high potential.

Curve Lake Area

1975 - Said to support year-round use by moose, but possibly limiting in winter due to snow depths.

1989 - Those observations apparently still pertain, although some cutblocks in the area are now being used by the animals.

Manson Peninsula

1975 - Some winter use by moose in regenerating strips along the shoreline, cleared for the reservoir.

1989 - Those observations still pertain--it has relatively low accessibility in terms of continuity with neighboring winter ranges.

Manson River

1975 - The river flats reportedly used by moose throughout the year, but adjacent benches mostly covered by mature timber and having "...low wildlife values".

1989 - There is still evidence of regular use of the riparian areas along the river--the only major drainage in the study area for which that was found to be true. However, a proliferation of appropriately aged cutblocks in adjacent uplands has enhanced moose wintering values there.

Blackwater Creek -

1975 - Described as being similar to 15-Mile Swamp in vegetation characteristics, and important to moose in winter.

1989 - In our surveys, the shrub associations along the creek were far higher than in 15-Mile swamp, and were well-used (judging both from tracks and direct observations) all the way from Blackwater Lake to the lower few km.

15-Mile Swamp

1975 - Referred to as "Blackwater Swamp", this area was considered "...an excellent moose wintering area".

1989 - Although wind action apparently reduces the local snow cover in at least portions of the swamp, there were few protruding shrubs over most of its expanse, and moose wintering activity was primarily scattered (sparsely), along the edges. Use is probably heavier earlier in the winter.

Uplands bounded by Blackwater Creek, Nation Arm, and the west shore of Parsnip Reach

1975 - Reportedly little used by moose, except in summer; subjected to heavy logging in the 1970's and subsequent high hunter kill due to increased access.

1989 - Although the huge series of cutblocks in this upland area includes many that are too new and/or poorly revegetated to support moose, there was concentrated sign at several locations and the local density in terms of animals actually seen was among the highest in the entire study area.

Dastaiga Creek

1975 - Much of the area described as an old burn (over 30 years) which had grown beyond the peak period of successional growth for moose production.

1989 - Although there are some nice looking riparian shrub areas scattered throughout the Dastaiga-Nation area, snow depths appeared to be limiting on most of the flat uplands there, and only occasional animals and sign were evident.

Tsedeka Creek

1975 - "Between Tsedeka Creek and the Reservoir there are large areas of select-strip logging that provide excellent moose winter range." It was expected that those areas, and a new clearcut nearer the reservoir, would increase in value to moose as deciduous growth increased.

1989 - Consistent with the prediction, our surveys found concentrated sign throughout the above area.

Didche/Modeste Creeks Area

1975 - Reported as important to moose all year.

1989 - There was little sign in February 1989, with snow depth appearing to be the limiting factor at that time. The area may be used only in some

winters, and/or early in all winters.

Scovil Creek

1975 - A large series of new cutblocks along the lower creek were predicted to have future values for moose wintering, but were little used at the time.

1989 - The prediction appears to have been borne out--moose, snowshoe hares, and tracks of both were common to abundant thoughout that area in February 1989.

Lignite Creek

1975 - Some use by moose in deciduous and mixed forest uplands in the vicinity of Grayling Lake.

1989 - The presence of several new cutblocks and apparently deep snow resulted in this area showing little actual or potential use by moose in 1989.

Pack River

1975 - The riparian area was inundated by the reservoir, but old strip-logged areas upslope to the west were reportedly used by moose throughout the year--especially in winter.

1989 - Although we saw few moose in the area, owing primarily to the presence of a good conifer cover, fresh tracks were common. The Pack River shoreline is still useless for moose, and the uplands are still apparently good.

MANAGEMENT UNIT 7-30 (NORTH TO SOUTH)

Finlay Bay/Canty Creek

1975 - Described as a relatively heavy snowfall area, with little winter use by moose.

1989 - That assessment is still current.

Weston Creek

1975 - Local mature conifer habitats were considered "...important to wintering moose...", but new and proposed cutblocks were expected to enhance wintering potential.

1989 - Although there is no certain basis for comparing use then and now, the cutblocks in question were certainly receiving use--supporting the only significant concentration of moose that we located in M.U. 7-30 north of Mackenzie.

Scott, Yahwa, Inati, Lattah Creeks

1975 - Despite the presence of riparian vegetation that appeared suitable, little winter use by moose was apparent, possibly due to snow depth limitations.

1989 - That assessment generally still pertains, and can be extended to the west-facing, deciduous dominated slopes in the area, which look better than the observed use by moose would suggest.

Six-Mile and Kimta Creeks

1975 - Judged as having "moderate" values, but moose winter range not specifically mentioned.

1989 - The comments, above, for the Scott Creek group also pertain here, although cutblocks near the mouth of Six-Mile Creek are developing good potential.

Patsuk and Lamonti Creeks

1975 - It was noted that existing cover supported moderate browsing opportunities, and predicted that cutblocks near the lower reaches of these creeks would enhance their wintering potential for moose.

1989 - Moose were present in that area during our surveys, although not many were seen. The apparent karst terrain extending from the mouth of Lamonti Creek almost to Cut Thumb Creek was heavily tracked by moose, particularly in and near the few cutblocks in the area.

Cut Thumb Creek, Dina and Heather Lakes

1975 - The lower portions of the creek were considered "...good winter range for moose", but the areas around the lakes were of low value.

1989 - Our surveys found relatively little moose sign, and there did not appear to be any significant potential given present cover and 1989 snow depths.

Tony and Tutu Creeks

1975 - The general area includes local sites rated as "moderate to good" for moose wintering, and with a generally moderate rating for local upland deciduous forests.

1989 - We found little evidence of use around Tony Creek, but sign was fairly common along lower Tutu Creek out to and including the lowlands around Tutu Bay.

Mugaha and Morfee Creeks, and Gantahaz Lake

1975 - Lower Mugaha was considered "fairly good" for wintering by moose, but with browse production limited by canopy thickness. The other areas appeared to have good potential for wintering moose, in terms of vegetation characteristics, but it was speculated that their utilization "...is limited by the proximity of Mackenzie".

1989 - We found a few moose and abundant sign on the deciduous and mixed forest slopes facing south and west over Mugaha Creek, as well as along the lower creek out to and including swamps and low benches near the reservoir. The speculation relating to Morfee Creek and Gantahaz Lake remains plausible--snowmobile tracks were more common than moose tracks throughout that area during our surveys.

Mackenzie Area

1975 - The general area around the town was rated "low" for wildlife values, although Gagnon Creek was considered as having at least moderate year-round capability for moose.

1989 - During our surveys, the wetlands and mixed forest benches around Mackenzie supported more moose, judging both from sign and occasional sightings, than many of the areas farther north in M.U. 7-30. Gagnon Creek is discussed below.

Gagnon, Gataiga, and Mischinsinlika Creeks

1975 - Wetlands near the mouths of these creeks were considered to be important moose wintering areas.

1989 - Apparently the cutblocks in this area have developed to their present productivity relatively recently, since Bonar (1975) did not mention them. During our surveys this relatively small area supported the highest concentration of moose and snowshoe hare tracks and the highest density of observed animals in M.U. 7-30, and among the best in the entire study area.

APPENDIX 5. REPORT ON AERIAL SURVEY FOR CARIBOU IN THE WILLISTON RESERVOIR AREA, FEBRUARY 1989.

Purpose of Flight: Count and classify caribou in uplands of the Wolverine Range.

Location: Wolverine Range, Lower Omineca River area, northcentral B.C.

Date and Time: 17 February 1989; 0910-1235; 1320-1445
Weather: Clear, bright, cold, with light winds (ideal survey conditions)

Aircraft: Bell 206, JetRanger Pilot: Bob Batchelor
Observers: D. Hatler, Robert Quaedvlieg (A.M.), Ray Quaedvlieg (P.M.), S. Wasylik.

Species Key:

M = Moose	SS = Stone's Sheep	GB = Grizzly Bear
C = Caribou	DS = Call's Sheep	BB = Black Bear
W = Wolf	MD = Mule Deer	G - Mountain Goat

O = Other species, as designated under remarks.

Classification:
M = male; F = female; J = juvenile (young-of-the-year); Y = yearling; U = unclassified; A = unclassified adult.

Summary:

Caribou

A total of 214 caribou were counted in the Wolverine Range uplands, in a complete survey working from north to south. There were distinct trails leading into/out of the timber at the bottoms of most of the long, sloping fingers of alpine habitat on both sides of the range, but especially to the west. Thus, there may have been some animals in areas not surveyed, i.e., especially below timberline. Many of the alpine ridges in the northern half of the range had blown clear, or nearly so, while those in about the southern third appeared to be less affected by wind action and were not being used by the animals. Classification data for the animals seen are as follows:

	Bulls	Cows	Calves	Total
Number	46	133	35	214
Per Cent of Total	21.5	62.1	16.4	
Per 100 Females	34.6		26.3	

Mountain Goats

Six mountain goats were observed incidentally, including one unclassified adult (probably a male), a female with twins, and a female with one young. All of the goats seen were in the southern quarter of the Range, on SW-facing slopes over the Jackfish Creek drainage.

All observations are shown on the accompanying map (Fig. 5).

Location	Species	Remarks
Wolverine Range		Working the areas above timberline, from north to south; sightings are listed below by the individual groups encountered.
North end	C	Fourteen animals (11F, 3M); the males included 1 antlerless and 2 young (small-antlered) animals.
	C	Nineteen animals (9M, 7F, 3Y); most of the bulls were antlerless, but a precise count was not practical, as it would have required another pass and it was judged that they had been disturbed enough.
	C	Ten animals (1M, 7F, 1J).
	C	Seven animals (1M, 4F, 2J).
	C	Eight animals (4M, 3F, 1J); there are trails at the lower end of most of the long east/west fingers of alpine habitat, especially on the west side; many slopes are quite windblown, with bare patches.
Strandberg Crk	C	Twenty-seven animals (6M, 15F, 6J) spread out along the slope in small groups (8,4,1,7,4,5) that quickly joined into one herd on our approach.
Strandberg Crk	C	Four animals (3F, 1J), just over the hill to the north.
Mt. Porter area	C	Seventeen animals (14F, 3J), large west-sloping ridge to the southwest.
Fries-Eklund Crk	C	Twenty-one animals (4M, 15F, 2J) in scattered bands (1,2,2,2,14); this is the location where 19 animals were seen during a reconnaissance flight on 11 February.
	C	Seven animals (1M, 3F, 3J), farther southwest on the same ridge system.
	C	Three animals (3F), farther west on same ridge.
Jackfish Crk	C	Five animals (4F, 1J) on the west slope, west of the Eklund Crk headwaters.
	C	Two animals (2M), both large antlerless bulls, farther west out the above ridge.
	C	Four animals (3M, 1F): 3 antlerless bulls and 1 antlerless (= barren?) female, on the next ridge south.

Location	Species	Remarks
Jackfish Crk	G	One adult, probably a billy, tucked into cliffs at about 1200 m on the S-facing side of the above ridge.
Eklund headwaters	C	Five animals (1M, 3F, 1J) on the ridge at the head of the north fork; small-antlered bull.
	C	Fourteen animals (2M, 11F, 1J), in the head of the north fork valley.
Eklund Creek	WV	Fresh tracks of two wolverines leading down the ridge north of the creek.
LUNCH AND FUEL BREAK		
Eklund Creek	C	Ten animals (7F, 3J) on the ridge between the north and middle forks.
Jackfish Creek	C	Twenty-four animals (7M, 14F, 3J) in three bands (6,2,16) on the west-facing slope opposite the middle fork of Eklund Crk; nanny goat with
	G	twin kids seen on the ridge above the caribou.
	C	Five animals (5F), on the southernmost of the long, west-sloping ridges; at least one and probably two were yearlings; nanny and kid
	G	seen above cliffs along the lower section of that ridge, and numerous tracks around those cliffs suggest other goats may be present.
Eklund Crk	C	Eight animals (2M, 3F, 3J) on the headwaters ridge between the two branches of the middle fork.
South		No more animals or tracks seen; snow depths appear greater on the southern ridges, possibly because of less wind action.
END OF WOLVERINE RANGE CARIBOU SURVEY		
Mt. Bisson	C	On advice from Robert Quaedvlieg, who knows of summer caribou occurrence in these uplands, we passed by quickly enroute to other work; the alpine slopes of this area are deep in snow and with less obvious access from adjacent slopes; no wildlife sign.
END OF CARIBOU SURVEYS		

Fig. 5:
Flight lines and observations during aerial surveys in the Omineca River and Wolverine Range Areas, B.C., February 1989.

[x] - Observation numbers as listed in Appendices 1 and 2.

M = moose
C = caribou
Gt = Mountain Goat
Wv = Wolverine

APPENDIX 6. Small format (page size) maps showing survey flight lines and observations, as described in Appendix 1 and summarized in Appendix 2.

LEGEND

Flight lines:

Observation Number: In brackets (e.g. [10]). These numbers correspond to the observation numbers (1-241) listed in Appendices 1 and 2.

Observations:

M = Moose, C = Caribou, SS = Stone's Sheep, G = Mountain Goat
W = Wolf, WV = Wolverine.

The number in front of the species abbreviation refers to the number of animals seen, e.g., 2M = 2 moose.

Quotation marks (e.g., "2M") indicates uncertainty about whether the observation in question is correctly placed in relation to local cutblocks.

Tracks (Tx):

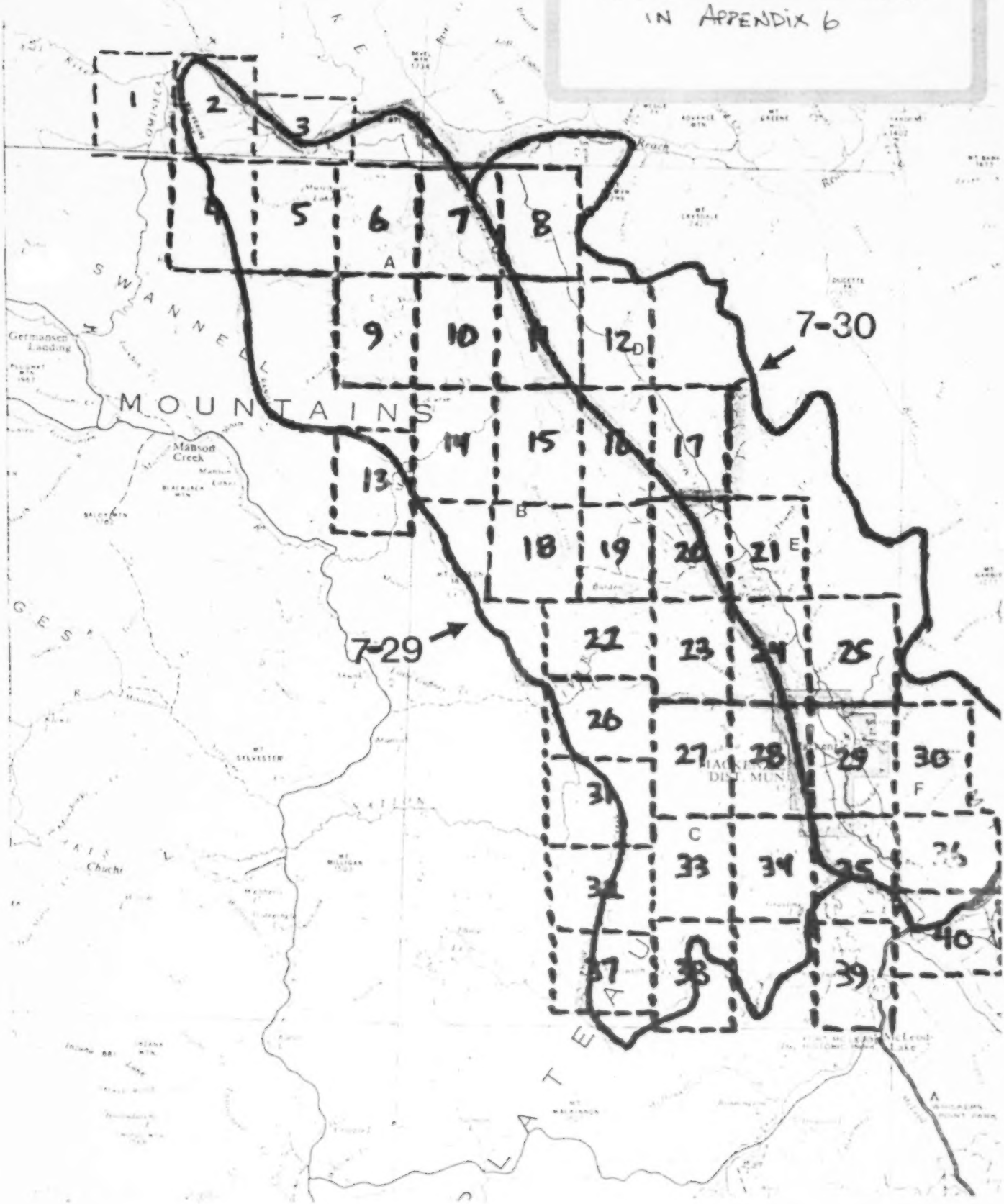
All entries refer to moose tracks unless indicated otherwise. In general, Tx was used in situations where fresh tracks were especially prominent and/or abundant, although not every set of tracks present is so represented. They can be thought of as indicated locations where we thought moose "should have been seen"--in at least some cases the individuals that made the tracks probably were seen eventually. A circle around the symbol for tracks (Tx) indicates old tracks only--signifying that one or more animals had been at that location in the past, but had apparently left.

Cutblocks: Boundaries of cutblocks catalogued on MOF maps are shown in red. Those maps are believed valid through 1987, but new blocks appearing since then are probably not shown. An "x" inside a cutblock indicates that it was not covered because it could be seen from a distance that it was too "new", too high, or otherwise unsuitable for moose. That convention was adopted in later days, thus was not done in most of the northern half of the study area.

Snow Measurements: The 3 numbers after the word "snow" indicates depths, in cm, of three probes with a measuring stick. Those data are summarized as averages in Fig. 3.

* * * * *

KEY SHEET FOR 40 MAPS IN APPENDIX 6



94 C/12

1

N

WOLVERINE RANGE

(SWANNELL RANGES)

Tx

Tx

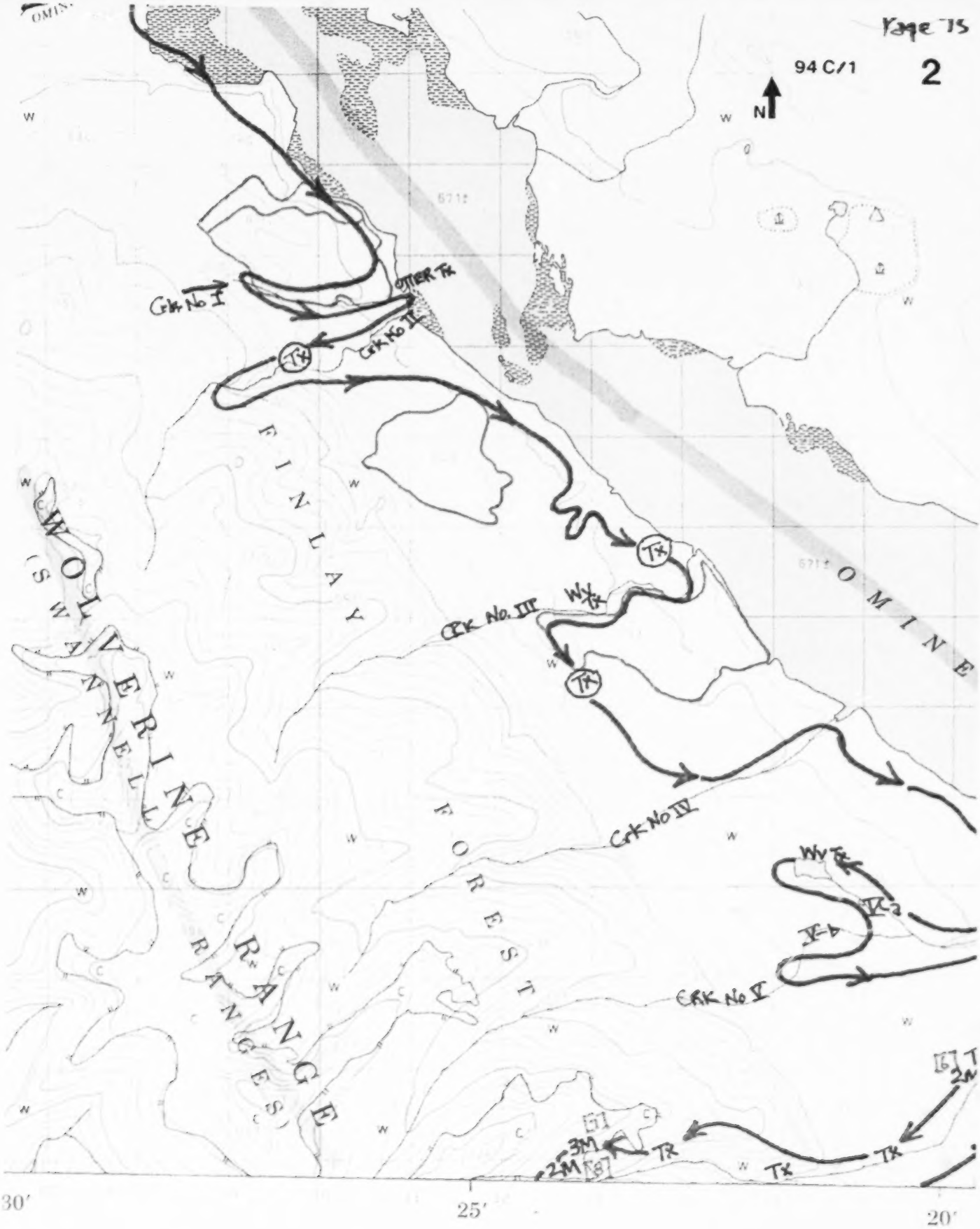
WTx

2M

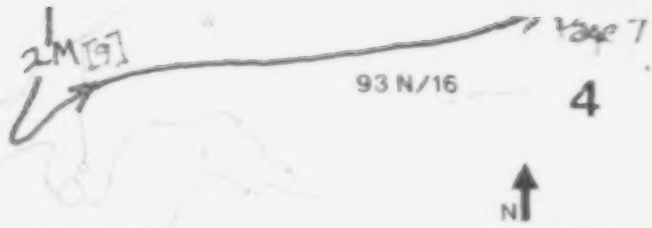
Tx

Tx

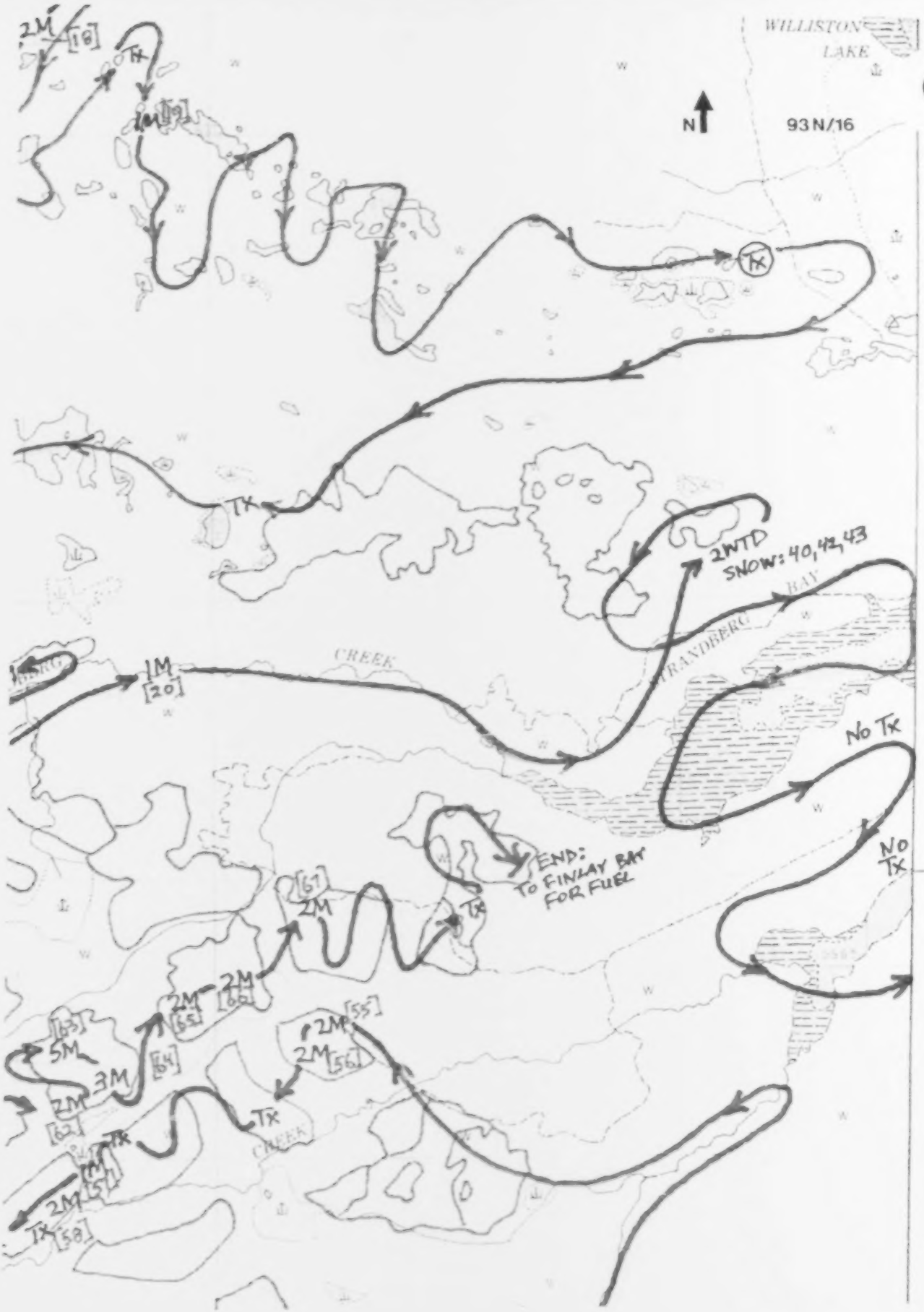
94 C/1 2


N
Crk No I
OTTER Tr
Crk No II
Tr
FINLAY
OMINE
WOLVERINE (SWANNELL)
Crk No III
Wv Tr
Tr
Crk No IV
FOREST
RANGE
Wv Tr
IV-3
IV-4
Crk No V
[6] T
2M
[5]
3M
2M
[8]
Tr
Tr
Tr
30'
25'
20'

94 C/1
N
WOLF
START
ARM

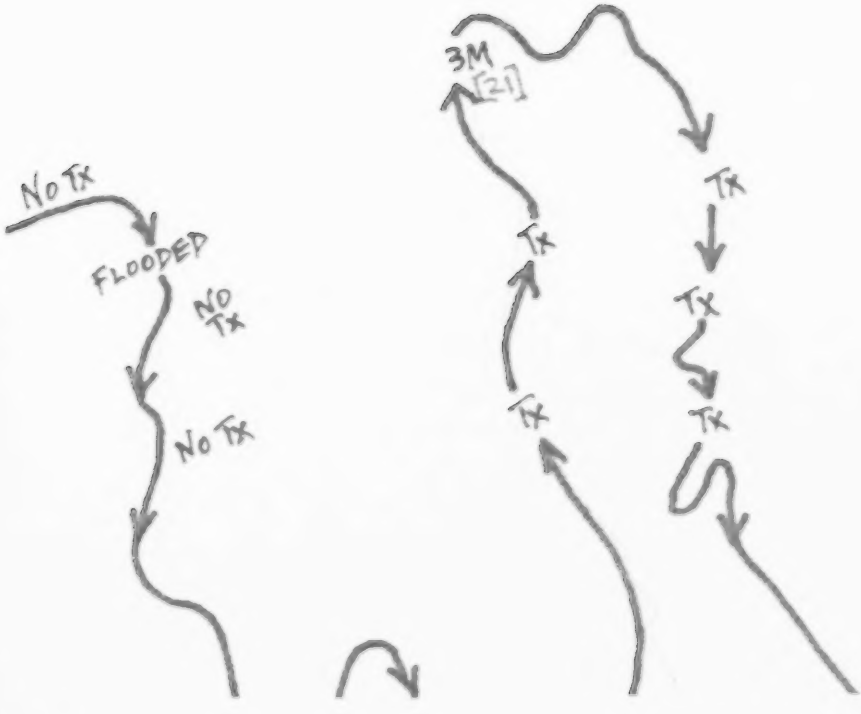

2½M[9]
93 N/16
4
N

5
N
93 N/16
XI-a
XI-b
XI-c
CRK NO VI
2M
[13]
[2]
[17]
3M
1M
2M
WALK
[15]
[16]
3M
2M
SNOW: 72,70,70
XI-d
[14]
END CLEARED 11TH
SNOW: 53,60,65
NO Tx
[47]
KM
2M
[48]
[39]
1M-1
[38]
15TH AM (6)
(S W E N N E L L)
[60]
2M
[61]
2M
[59]
1M
E I N L A Y F O R E S T
STRANDBERG

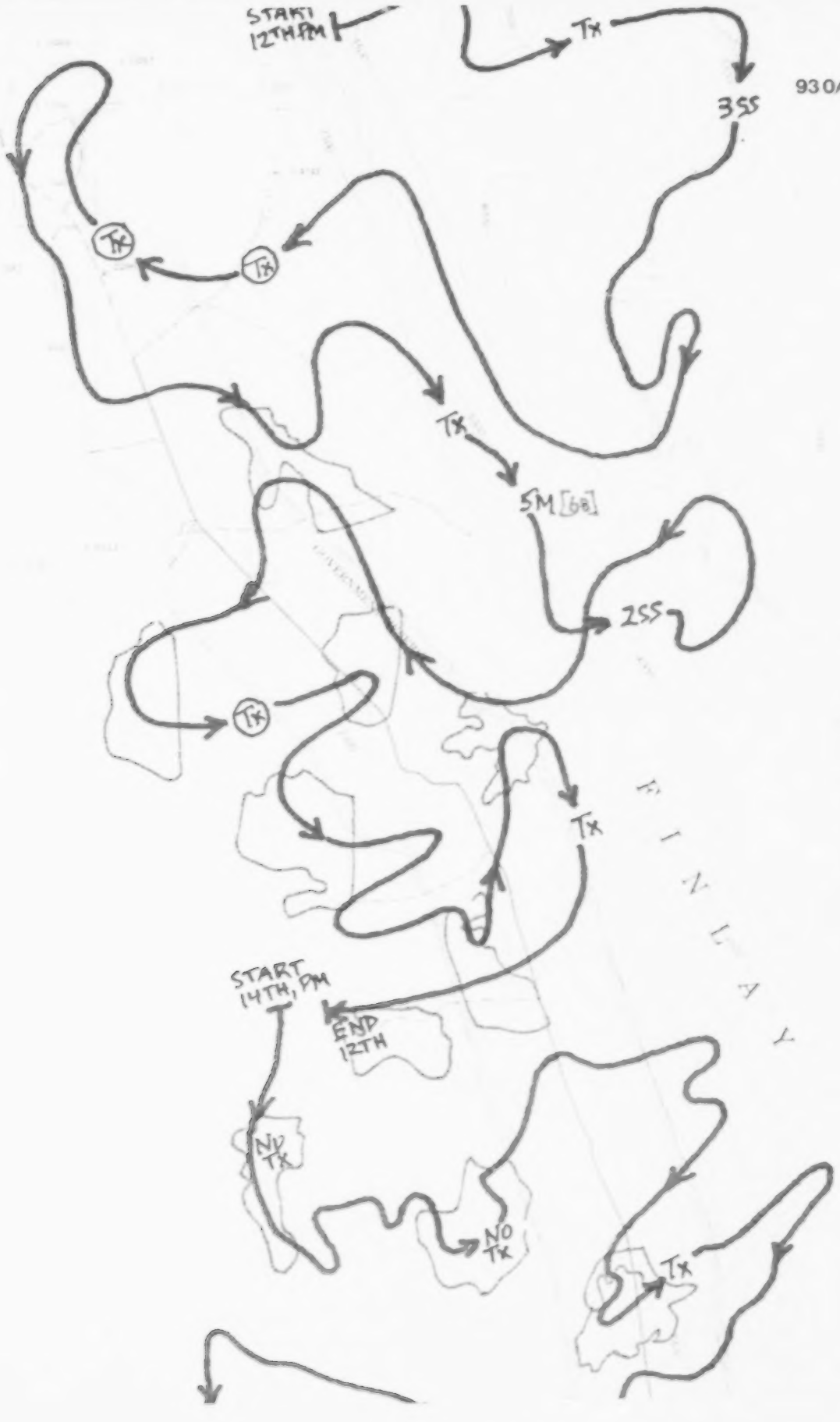

WILLISTON LAKE
6
N
93N/16
2M [18]
Tx
Tx
Tx
2WTD SNOW: 40, 42, 43
BAY
BRANDBERG
CREEK
1M [20]
No Tx
END: TO FINLAY BAY FOR FUEL
No Tx
55'
[61]
2M
Tx
2M
2M [65]
2M [66]
[63]
5M
3M
[64]
2M [62]
Tx
Tx
2M [55]
2M [56]
Tx
CREEK
2M [57]
2M
Tx [58]

7

N 930/13



930/13


START 12TH PM
Tx
355
N
Tx
Tx
Tx
5M [6e]
255
Tx
Tx
START 14TH, PM
END 12TH
NO TX
NO TX
Tx

N
93 N/16
Tx
Tx
Tx
1 COYOTE
Tx
Tx
SNOW:
R = 50 cm
SHOAL
LAKE
Tx
Tx
Tx
4M
[54]
WV Tx
SNOW:
52, 54, 55
[51]
3M
[52]
2M
4M
[53]
2M [50]

N
ROCKY
MOUNTAIN
TRENCH
FINLAY
FOREST
3M
1M [22]
Tx
Tx
Tx
Tx
Tx
Tx
Tx
Tx
Tx
Tx
"1M" [43]
"2M" [44]
"1M" [45]

N
Tx
2M
Tx
[123]
[124]
3M
1M
[125]
2M
[126]
1M
[127]
3M
2M
[132]
[129]
2M
1M
[130]
1M
[128]
Tx
10C
D
Tx
Tx
1M
[136]
Tx

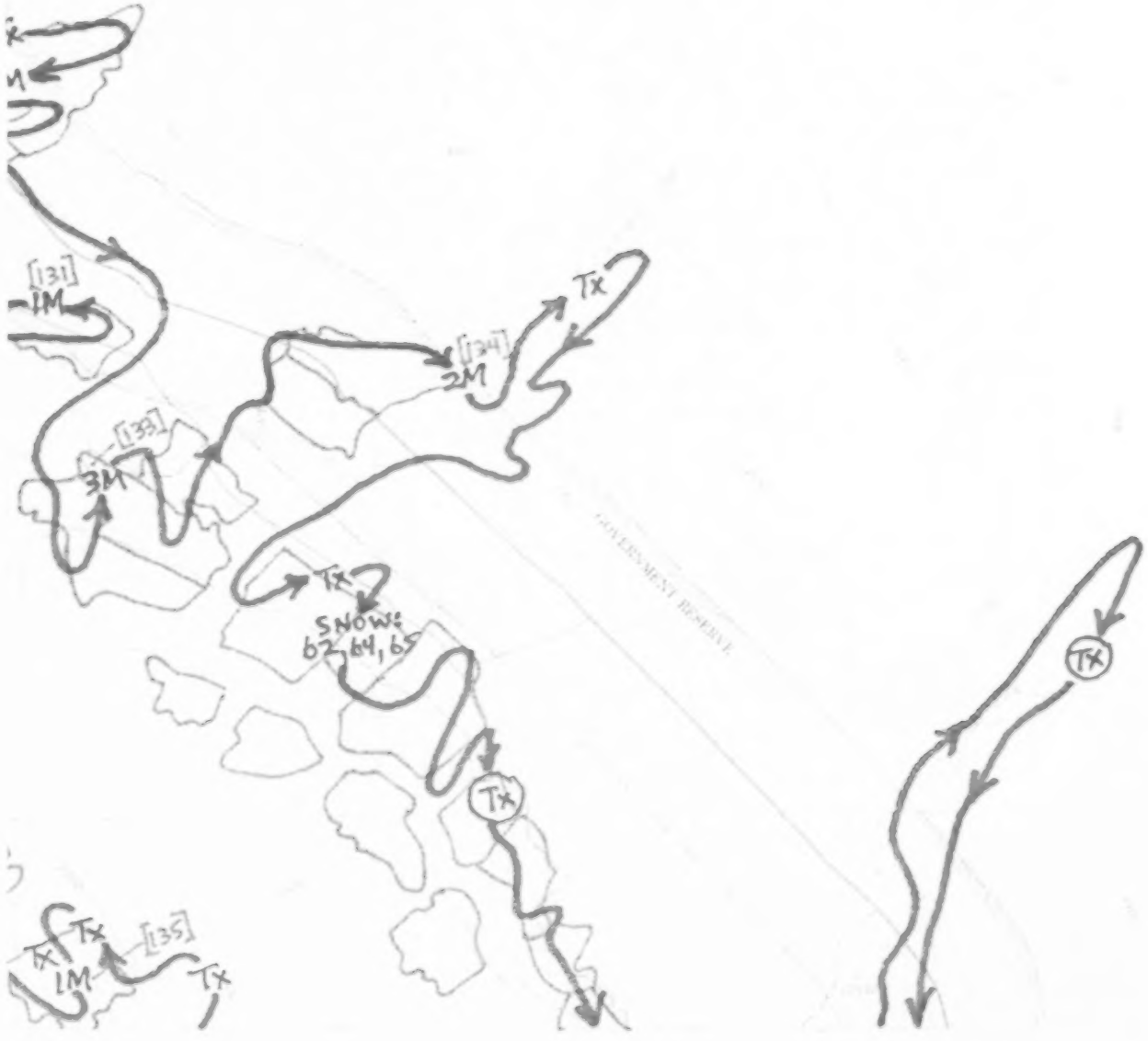
R A N G E S

930/13

N

H A R T R A N G E S)

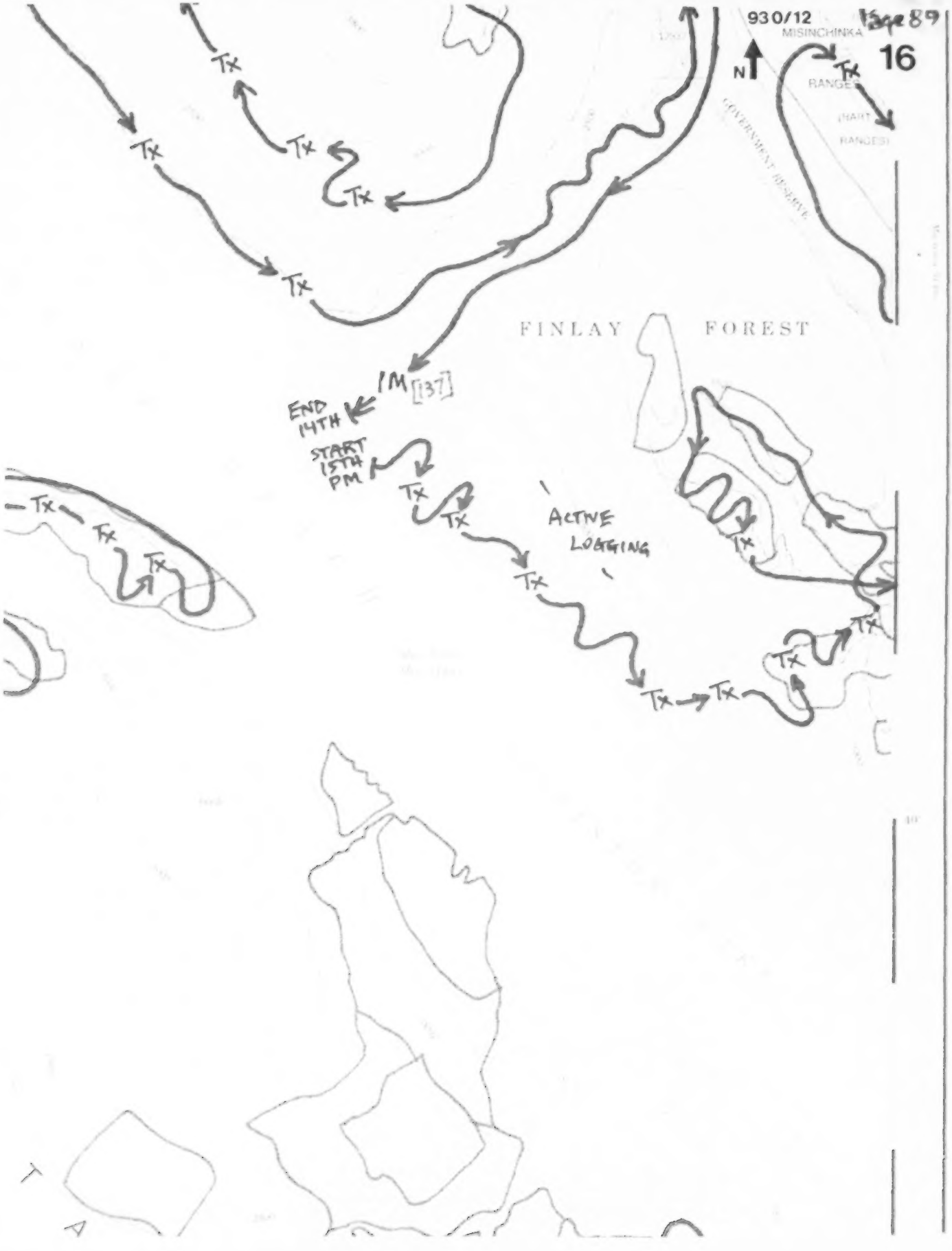
F O R E S T



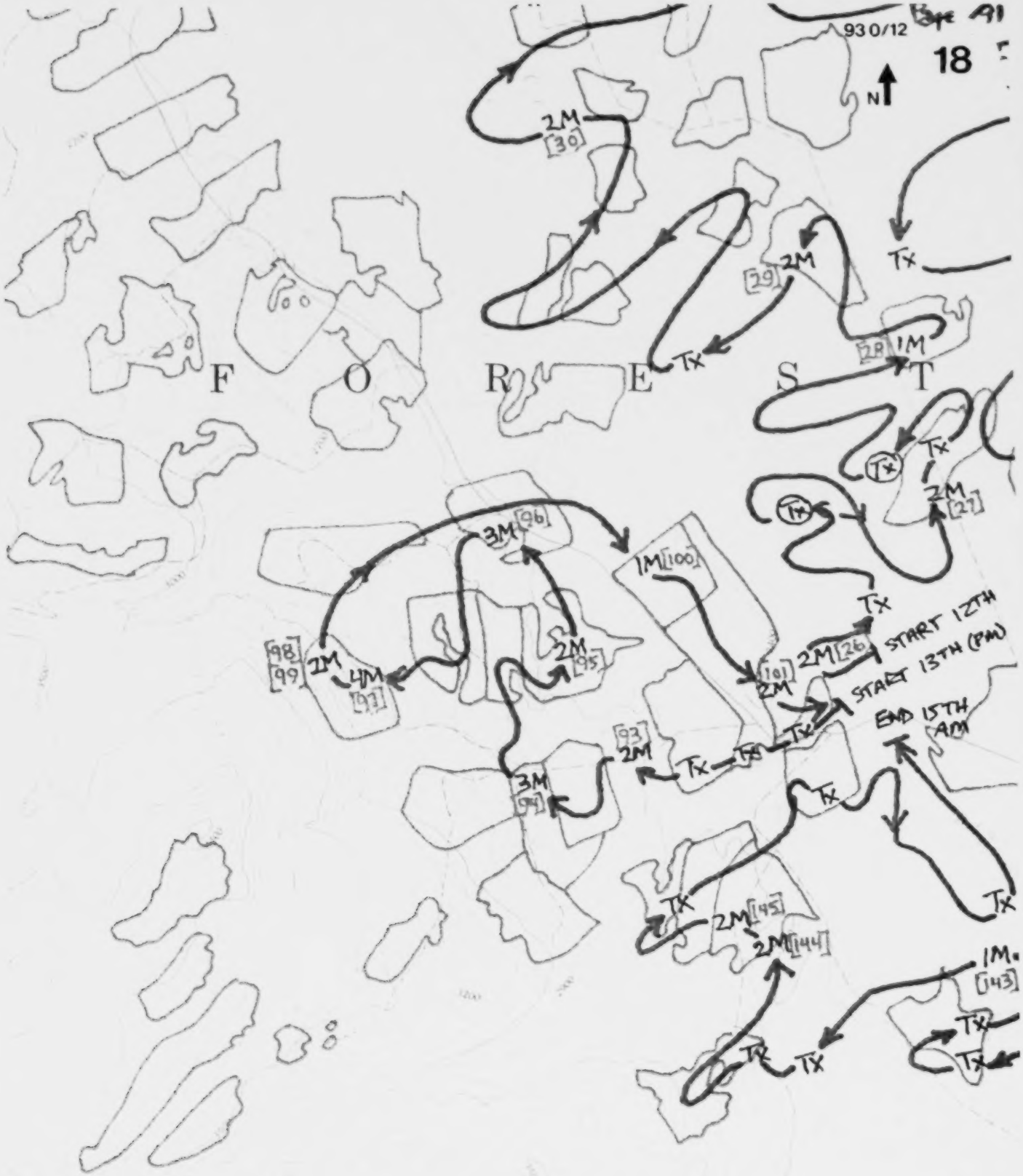
Hope 86
N
93N/9
13
RIVER
"2M"
"1M"
TX

N
"2M" [46]
4M [39]
2M [42]
2M [41]
3M [40]
WX Tx
Tx
[47]
1M
Tx
[33]
2M
2M [34]
END 12TH AM
3M [48]
19TH PM(1)
Thinned
2M [219]
11M [220]
2M [221]
"3M" [38]
[222]
2M
2M [223]
Thinned
1M [224]
[225]
3M
END 19TH PM(1)

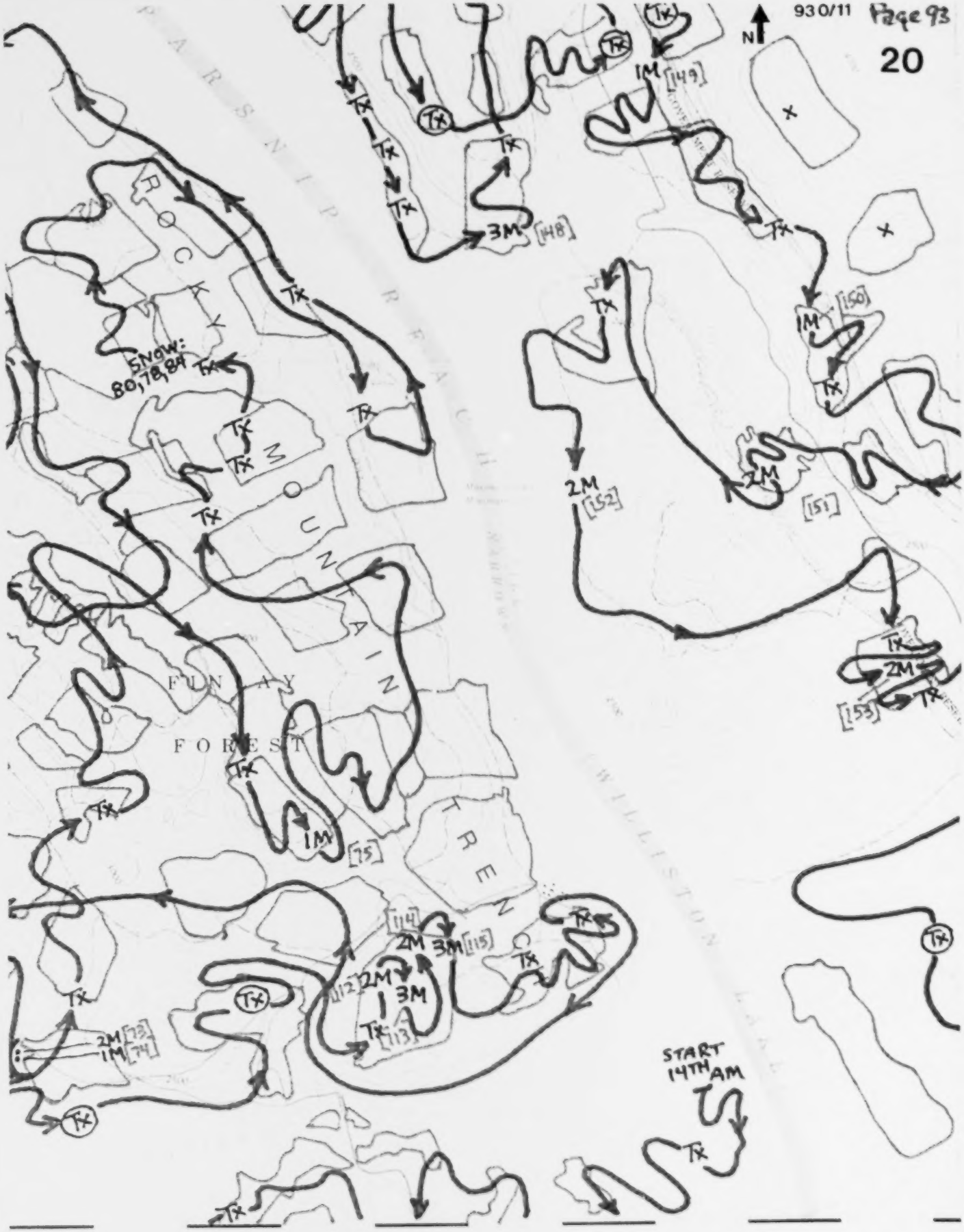
N
SNOW: 58,55,61
2M [32]
Tx
Tx
Tx
2M [23]
CTx
Tx
4C (seen in passing 14 Feb)
START 15TH AM(Z)
No Tx
BEGIN 12TH PM
SNOW: 39,28,31
2M [24]
[25]
2M
Tx
Tx
Tx
other Tx
END OF DAY (11TH)
Tx
FUR Tx
SNOW: 50,59,51
F I N L A Y
Tx
Tx
2M [31]
Tx


930/12
Page 89
MISINCHINKA
16
N
RANGES
(PART
RANGES)
GOVERNMENT RESERVE
FINLAY FOREST
Tx
IM [137]
END 14TH
START 15TH PM
ACTIVE LOGGING

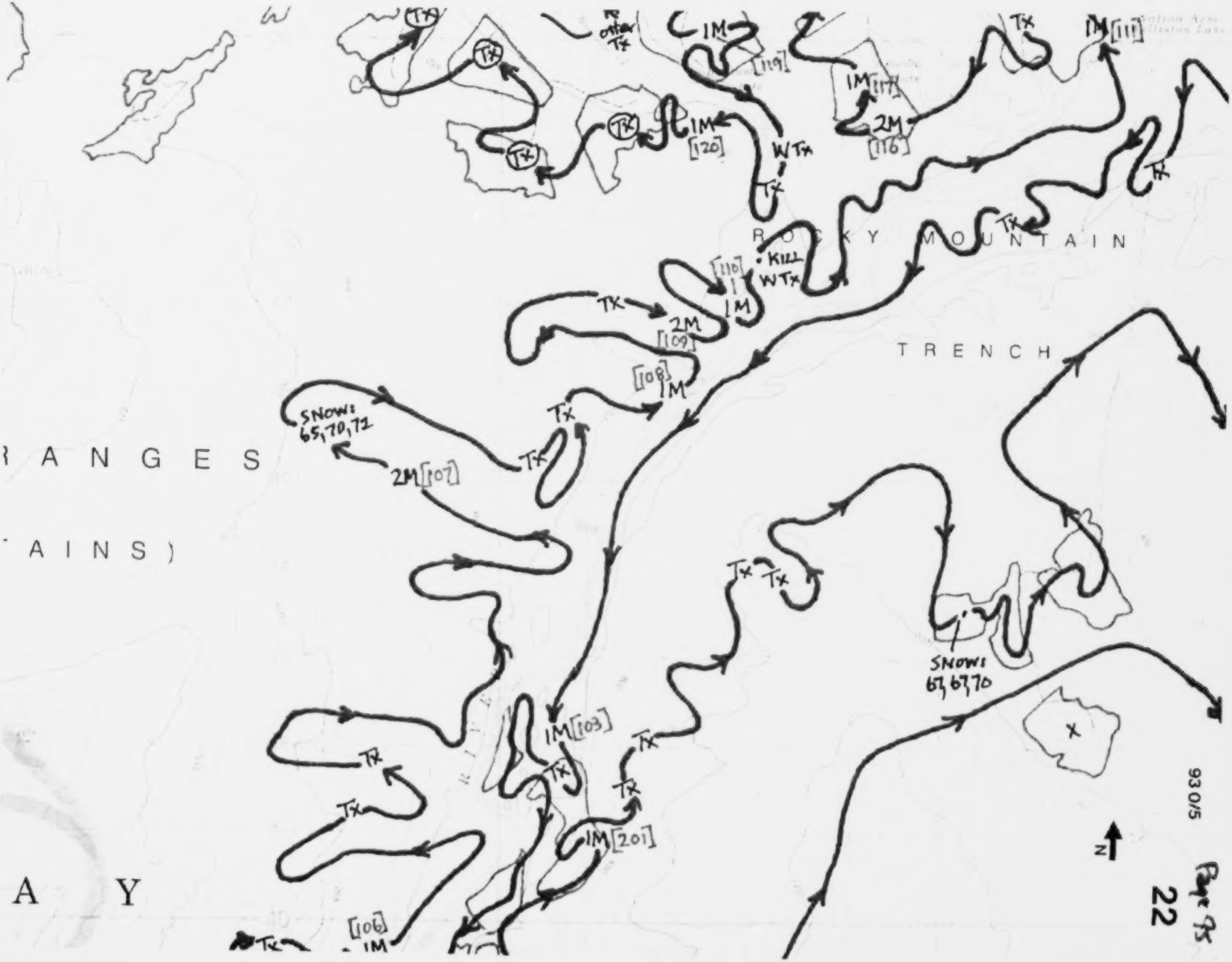
N 930/11


930/12
18
N
2M [30]
[29] 2M
Tx
2M [28] 1M
F O R E S T
Tx
Tx
Tx
2M [27]
3M [96]
1M [100]
[98] [99] 2M 4M [97]
2M [95]
[101] 2M
2M [26]
START 12TH
START 13TH (PM)
END 15TH AM
[93] 2M
Tx
3M [94]
2M [145]
2M [144]
1M [143]

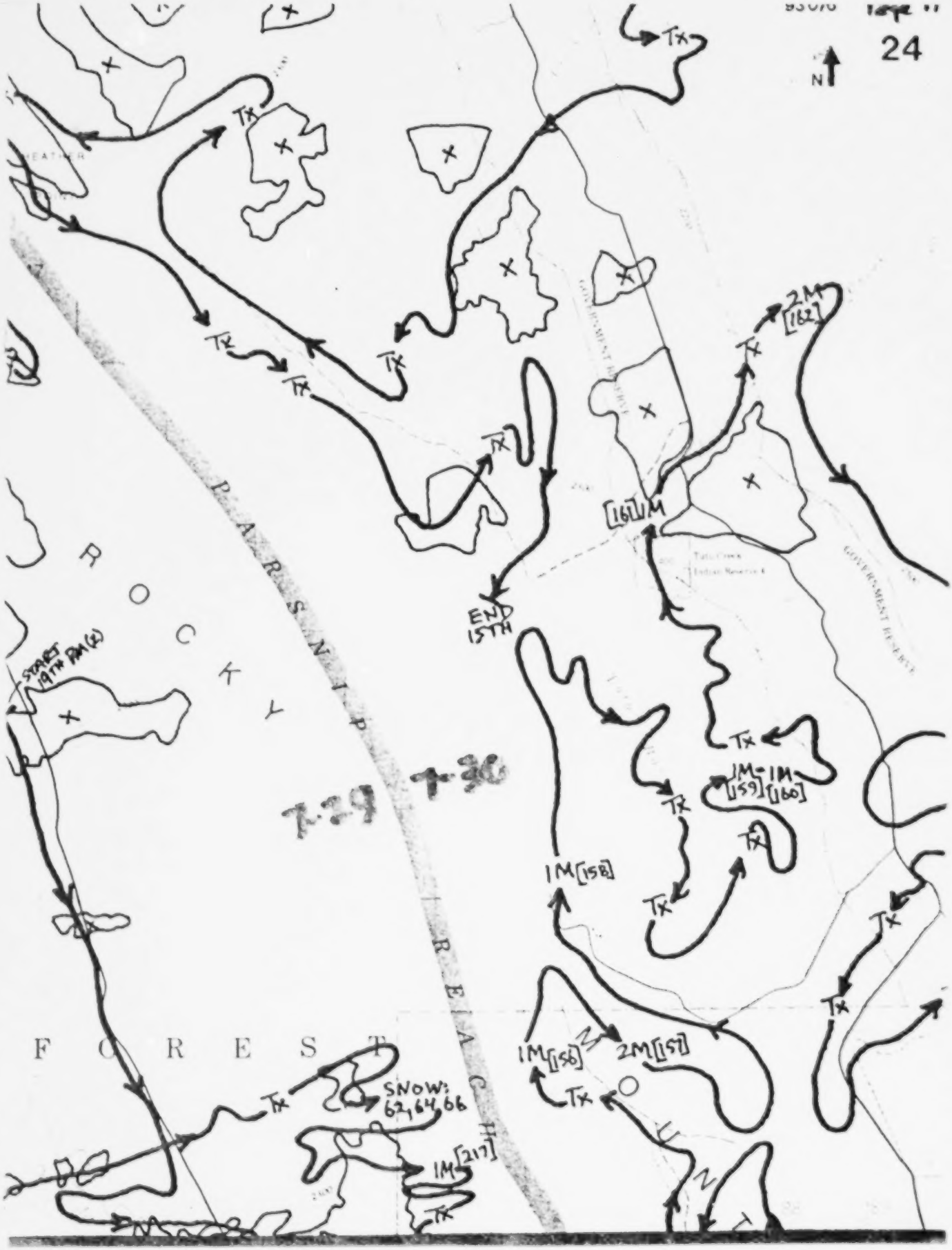
N
930/12
Tx
SNOW:
39,40,40
"1M"
"2M"
[83]
[82]
[79]
[78]
[85]
[81]
[86]
[84]
[80]
2M
[77]
3M
[76]
KHL
WV
Tx
SNOW:
70,78,74
[89]
[87]
[88]
[92]
STOP FOR FUEL
1ST A AM
[90]
[91]
END 14TH
4M
2M
[42]
START
13TH
3M
[23]
[69]
1M
[70]
[118]
[72]
[71]


N
ROCKY
MOUNTAIN
FUNAY
FOREST
TREN
Tx
1M
2M
3M
[148]
[149]
[150]
[151]
[152]
[153]
[75]
[112]
[113]
[114]
[115]
[72]
[74]
SNOW:
80,78,84
START
14TH AM

RANGES
Tx
Tx
Tx
Tx


TX
1M [119]
1M [117]
2M [116]
1M [120]
WTx
1M [111]
R O C K Y M O U N T A I N
[110] 1M
KILL WTx
2M [109]
[108] 1M
T R E N C H
SNOW: 65, 70, 72
2M [107]
1M [103]
1M [201]
[106] 1M
SNOW: 67, 67, 70
X
N
93 0/5
Page Rx
22

930/6
N
[202]
2M
[203]
1M
[204]
3M
[205]
[206]
[207]
19TH PM (2)
SNOW: 90,9992
2M [216]
FINLAY


N
Tx
X
ROCKY
MOUNTAIN
FOREST
RESERVE
PARSNIP
START 19TH PM(E)
END 15TH
[161]M
2M [162]
1M [158]
1M [159] 1M [160]
1M [156] 2M [157]
SNOW: 62, 64, 66
1M [217]

N
25
Tx
2W
Tx
Tx
Tx
Tx
MISINCHINKA RANGES
FINLAY FOREST
1M [165]
Tx
1M [164]
2M [163]
Tx
Tx
Tx
SNOW: 45,48,48
1M [166]
Tx
Tx
Tx
SKIDOO TX
Tx
PEACE RIVER LAND DISTRICT
CARIBOU LAND DISTRICT
Mount Morfee
MACKENZIE DISTRICT MUNICIPALITY

N

START 17th DAY

[105]

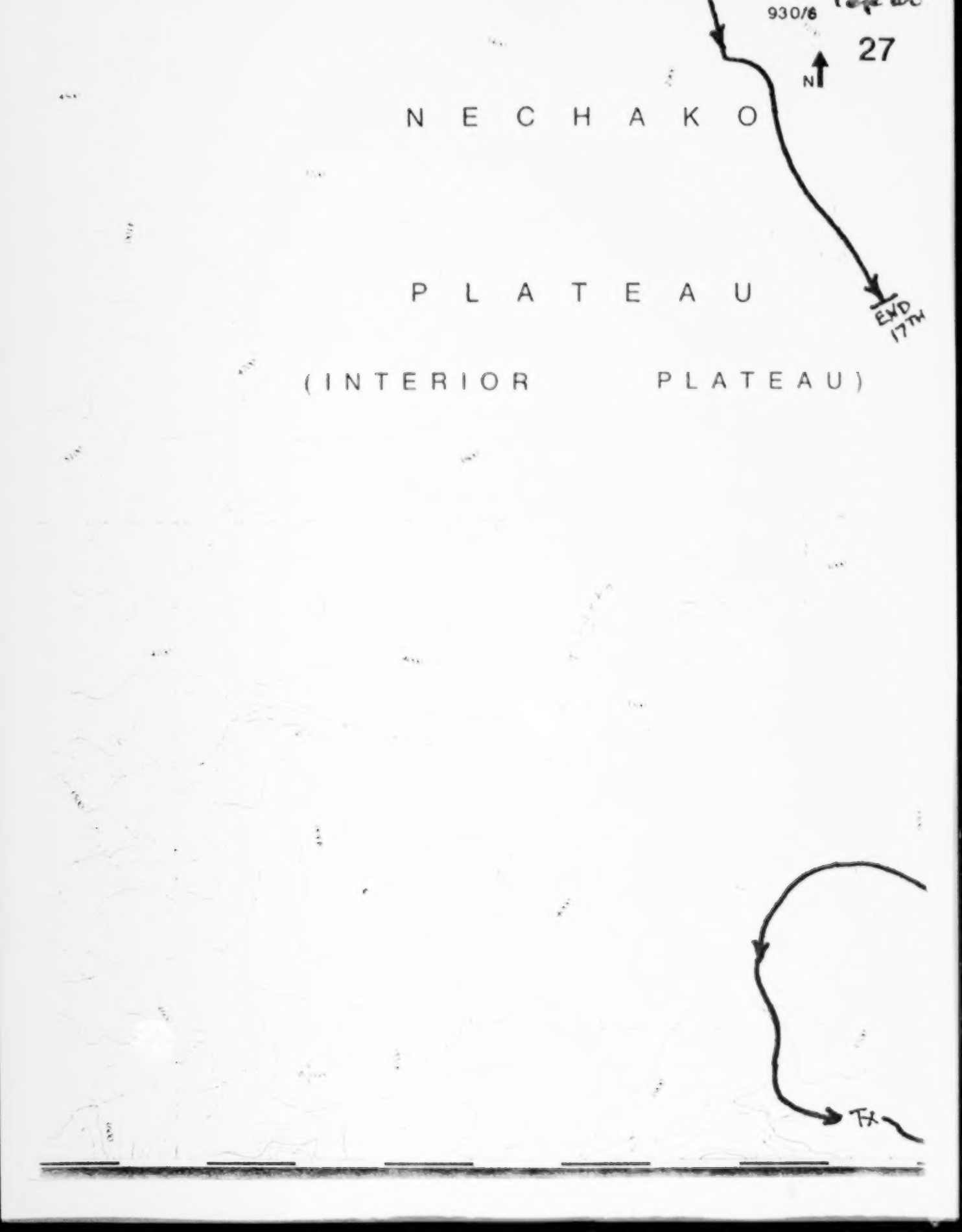
[101]

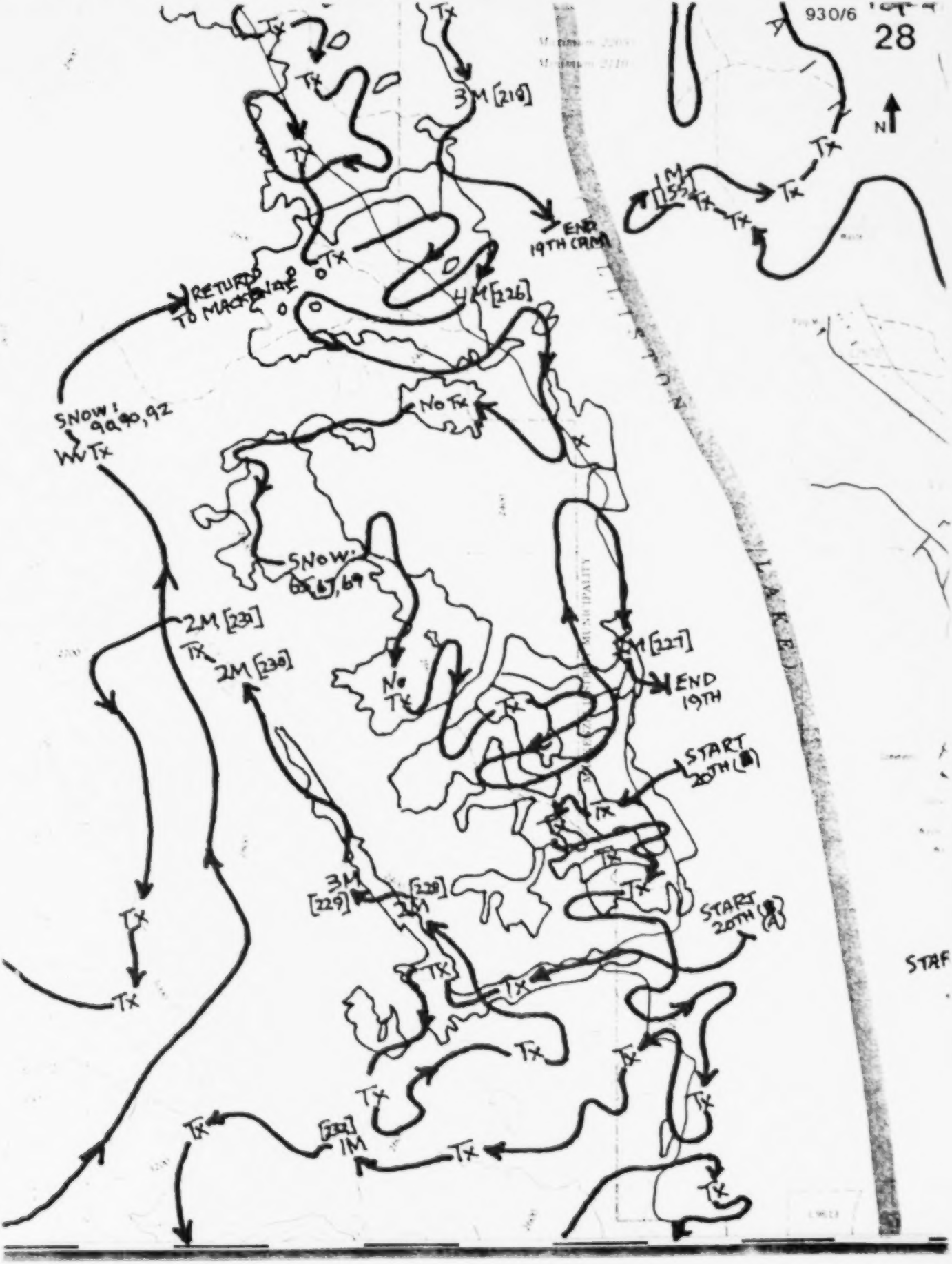
[200]

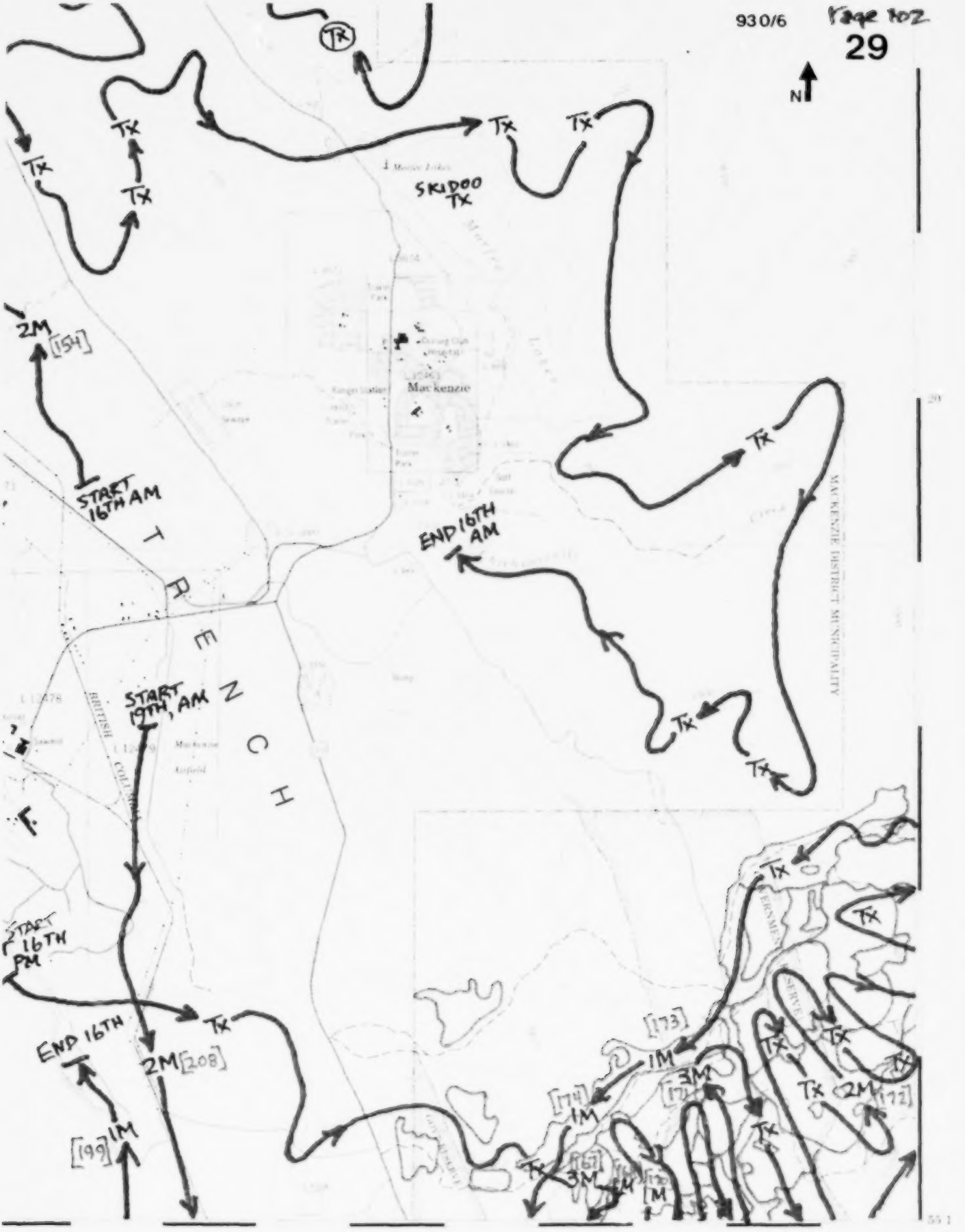
S T

L A T E A U

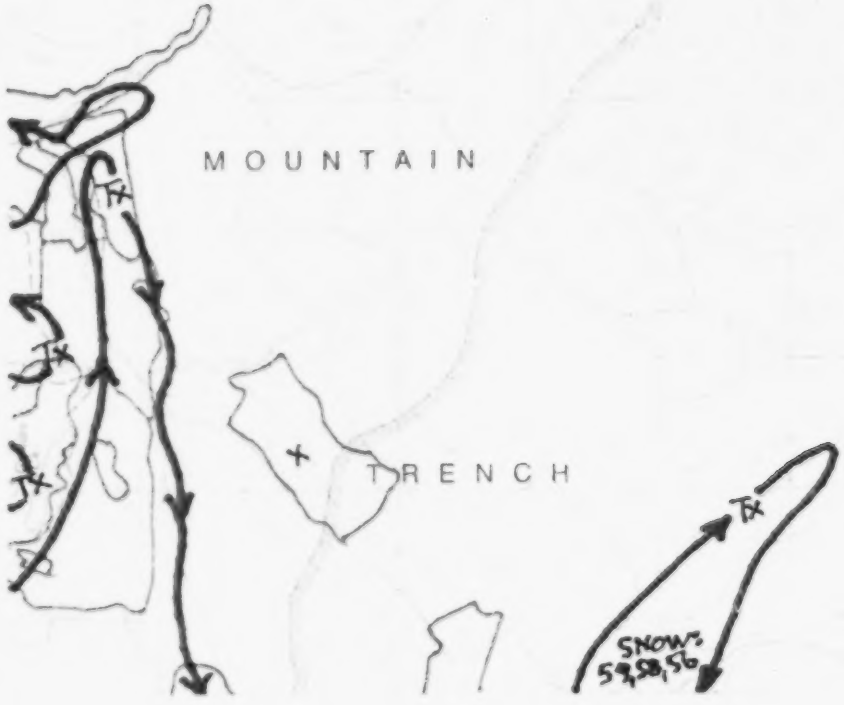
A T E A U


930/6
27
N
N E C H A K O
P L A T E A U
END 17TH
(INTERIOR PLATEAU)
TX


930/6
28
N
Tx
3M [218]
END 19TH CAM
RETURN TO MACKINAW
4M [226]
No Tx
SNOW: 90,92
SNOW: 67,69
2M [231]
2M [230]
1M [227]
END 19TH
START 20TH (B)
START 20TH (A)
3M [229]
[228]
[232]
1M
LAKE


N
Tx
SKIDOO
Tx
2M
[154]
START
16TH AM
END 16TH
AM
Mackenzie
MACKENZIE DISTRICT MUNICIPALITY
START
19TH, AM
START
16TH
PM
END 16TH
2M[208]
[199] 1M
[173]
1M
[174]
1M
3M
[172]
2M
3M

N



930/5
Page 104
31
N

K O

A U

A T E A U)

930/4 Page 105

32

Mount
Scovil

93 O/3

Page 106

33

N

FINLAY FORE

NECHA INTE

Skeg
Mountain

34
N
Tx
END 20TH
1M [234]
1M [233]
2M [241]
1M [238]
[239]
2M
1M [240]
HARES
[237]
2M
2M
[235]
[236]
SNOW: 70, 72, 75
SNOW: 67, 70, 74
WTx
S T
R I O R
P L A T

N
ROCKY
MOUNTAIN
TRENCH
PARSNIP
Tx
1M
2M
3M
4M
[169]
[173]
[178]
[180]
[181]
[200]

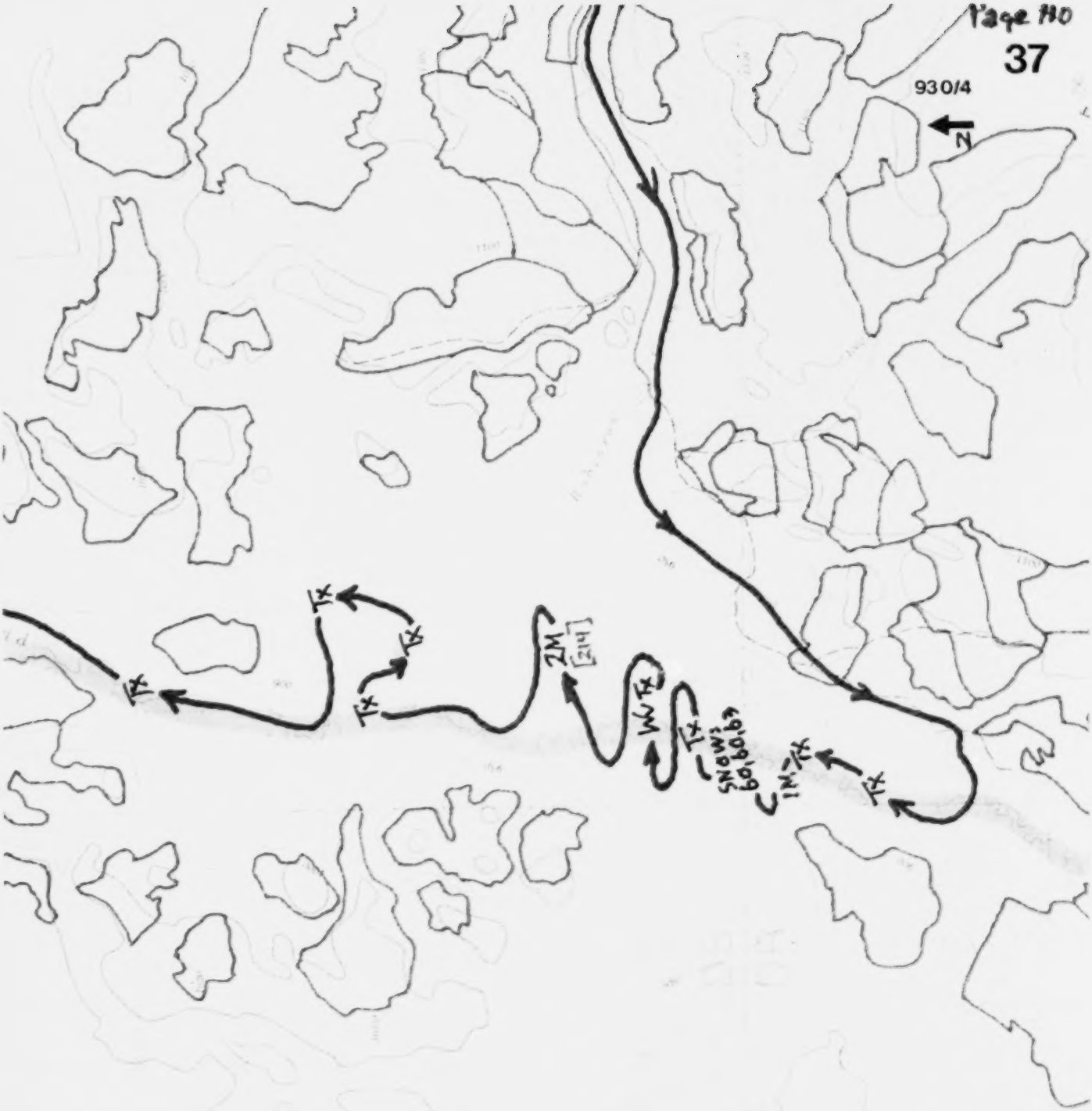
Stage 169

36

930/2

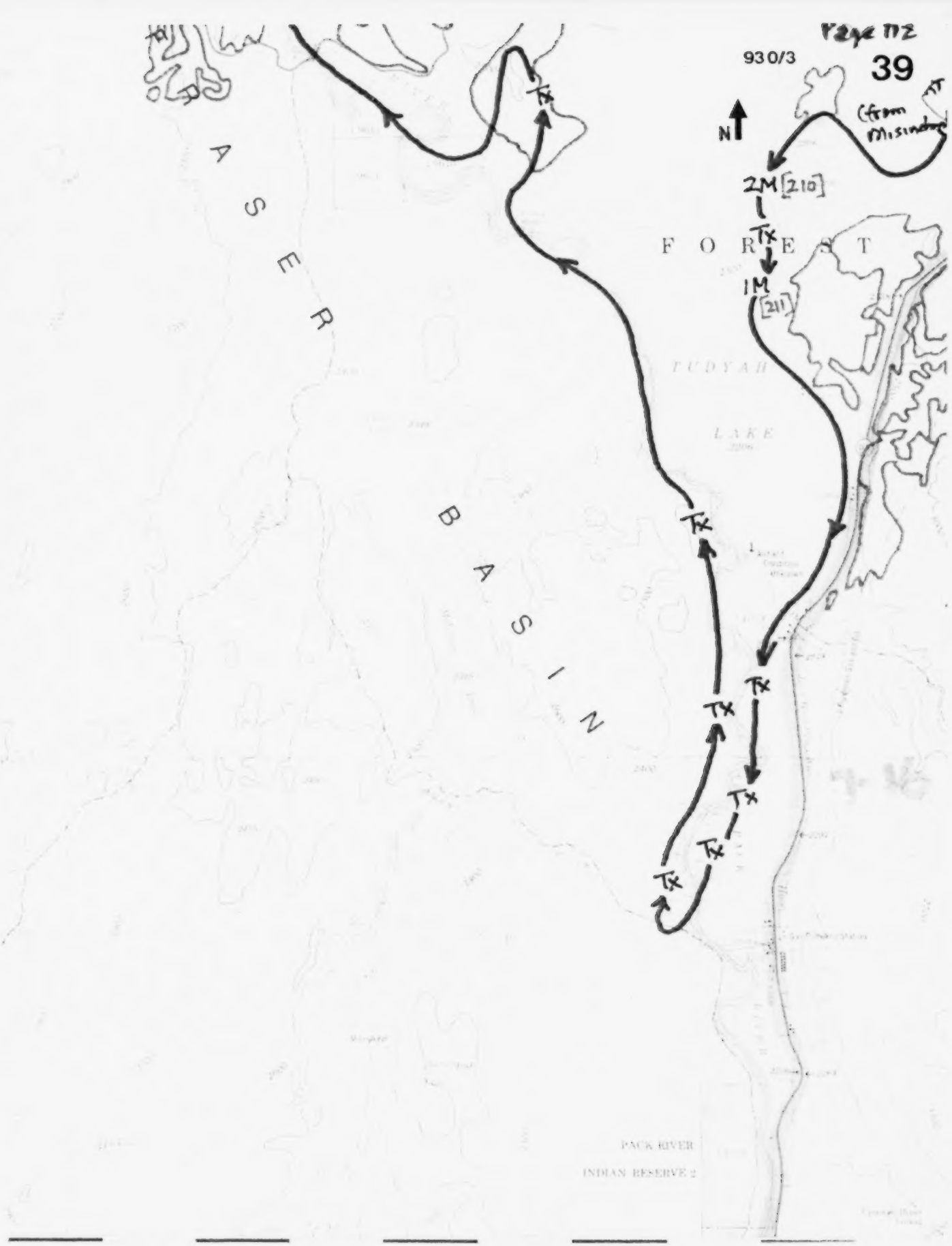
N

[98] 1M
[58] 2M
[88] 2M
[88] 1M
[68] 2M
[68] 1M
[96] 1M
[96] 2M
[68] 2M
[68] 1M
[16] 1M
1X
1X
1X


93014
N
1x
1x
1x
1x
2M
[2H]
1W-1x
1x
SNOW!
1M-1x
1x

930/3

N


Page 112
930/3
39
N
(from Misinchinka)
2M [210]
1M [211]
Tx
FOREST
ASER
BASIN
TUDYAH
LAKE
PACK RIVER
INDIAN RESERVE 2

R O C K Y
M O U N T A I N
P A R S
T R E N C H
END
(To TUDYA LK)
BRITISH COLUMBIA
GOVERNMENT RESERVE
MISINCHINKA
Kennedy
PARSNIP
93 O/2
N
Page 113
40